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A FORAMINIFERAL FAUNA FROM THE GUAYABAL FORMATION IN MEXICO

BY

W. STORRS COLE

Presented to the Graduate School of Cornell University in partial fulfillment of the requirements for the degree of Master of Science

December 23, 1927

Harris Co.
Ithaca, N. Y.
U. S. A.

A FORAMINIFERAL FAUNA FROM THE GUAYABAL FORMATION IN MEXICO

BY W. STORRS COLE

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INTRODUCTION

The geologists of the Aguila Petroleum Company during their stratigraphic studies of the Mexican formations chose as their type locality, for one of these, a cliff of chocolate colored shales, outcropping twelve kilometers due east of the village of Potrero in the state of Vera Cruz, Mexico. To these shales, they gave the formation name Guayabal, from a small Indian village in the near vicinity of the outcrop.

During the past year, I had the opportunity of visiting this locality and collecting various samples. Studies of the microscopic fauna from these samples, made evident the relationship of the fauna to a small one described already by Cushman[1] from the Moctezuma river. With the exception of *Operculina oliveri* Cushman, all the species mentioned in his paper may be found in the Guayabal type samples.

As a complete paper on the fauna of this formation has not yet appeared or as a type locality has not been designated officially, the purpose of this paper will be an attempt to record a complete enough foraminiferal fauna to make the formation recognizable in well-sections and surface samples and to place a standard name on record for this set of shales.

ACKNOWLEDGEMENTS

I wish to express my appreciation to Mr. Carroll H. Wegemann, chief geologist of the Pan-American Petroleum and Transport Company, for his permission to use Company material together with my personal samples, in the preparation of this paper. Acknowledgement is also due

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[1] J. A. Cushman; Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, pp. 298-303, pls. 6-8, 1925.

Mr. Ellis A. Hall and James B. Dorr of the Huasteca Petroleum Company, Tampico, Mexico, for their aid in obtaining necessary samples and data. I am indebted especially to Mr. Dorr, for valuable suggestions and stratigraphic information which he gave very freely while I was in Tampico and during the preparation of this paper. To Professor G. D. Harris of Cornell University, I feel very grateful for advice on this paper and for the use of his excellent laboratory facilities; and may I also mention his inspiring influence while writing this paper. To Katherine V. W. Palmer, to my wife and many others, I am indebted for suggestions, friendly criticisms and advice.

DISCUSSION

The Guayabal formation in its type outcrop is a bank of massive indurated clay of chocolate or reddish brown color. It is about twenty feet in height and extends approximately fifty yards before it is covered with debris. This material breaks with a conchoidal fracture. In the middle of the cliff there is a slightly more arenaceous zone which is better stratified than the clay-shale above and below it. Numerous hard, argillaceous, brown concretions with a carbonate of iron bond are interstratified throughout the deposit, especially in the arenaceous zone. Apparently the beds have suffered little or no deformation and lie in place.

In the wells in the producing region around Cerro Azul, the Guayabal is encountered from forty to one thousand and twenty feet below the surface. In this region above the Guayabal, lie un-named beds of greyish clay-shale which contain numerous *Globigerina* and *Hantkenina alabamensis* Cushman. *Globigerina mexicana* Cushman has a range of about eighty feet directly over the Guayabal which makes it an excellent marker in indicating proximity to the "brown shales." As yet, no name has been proposed for these grey, Globigerina-Hantkenina indurated clays overlying the Guayabal. For these beds, I propose the name "Chapapote" from the village of Chapapote. This formation outcrops typically on the north bank of the Tuxpam river a hundred yards down stream from the place where the trail from Alamo to Potrero crosses the river at Chapapote. These strata have been known generally to the geologists of Tampico as the Tierra Blanca beds or, in some cases, as the Upper Guayabal beds.

The Guayabal has an average thickness of about fifteen hundred feet, the least thickness from well-sections being three hundred and thirty feet and the greatest fifteen hundred and thirty feet. The original thickness was not probably much more than the average thickness. Little is known of the lateral extent except that the formation thins toward the northwest.

Below the section under discussion, lie other beds of greyish indurated clays also Globigerina in character. The species of *Globigerina* is different from that found in the indurated clays above and is easily recognized. This *Globigerina* is often associated with *Hantkenina mexicana* Cushman, although this form is not always present in samples.

So far as is known, the Tantoyuca formation[2] does not outcrop or occur in wells around Cerro Azul. As the Tertiary stratigraphy of the Tampico Embayment region is studied in greater detail, it becomes evident that the conclusions reached by some of the former workers must be somewhat altered as a result of the accumulation of new information. Thus, I consider *Robulus mexicanus* (Cushman), *Nodosaria mexicana* Cushman and *Anomalina umbonata* Cushman to be the best markers for the Guayabal. These may extend into the Tantoyuca, but if they do this, they occur very rarely in that formation. *Globigerina mexicana* Cushman, as before stated, is one of the best markers of the basal Chapapote. In this connection, I would like to state that the Chapapote is probably a deep water phase of the Tantoyuca[3]. Mr. James B. Dorr of the Huasteca Petroleum Company intends to publish in full on the Tantoyuca. His paper has already been published by title in the Bulletin of American Association of Petroleum Geologists. Therefore, I do not care to enter into any further discussion of this formation, except to say that I have seen samples from what is supposed to be the type locality of the Tantoyuca. These samples differ in both their lithologic and faunal character from any of the Tertiary formations under discussion in this paper.

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[2] Ben Belt; Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 1, p. 143, 1925.

The section that is now considered Guayabal by most of the paleontologists in Tampico, should be divided probably into two formations; the upper, corresponding to the Guayabal as exposed in the type locality; the lower, corresponding to the Tempoal as described by Belt[4].

I have compared samples from the Tempoal type locality with well-sections particularly in Cerro Azul number fifty-three of the Huasteca Petroleum Company, and a very excellent foraminiferal and lithological correlation may be made. The two formations, if they exist as such,[5] are evidently related closely; many species being common in samples from both type localities.

In spite of the proof that I have, I hesitate to make a definite statement until field work is done and the actual contact is found exposed and samples examined from each side.

As a tentative section, in order to standardize the Eocene of the so-called Southern Field district (the producing region around Cerro Azul) I would like to propose the following:

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[3] Personal communication from Mr. James B. Dorr.

[4] Ben Belt; Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 1, p. 143, 1925.

[5] Note: Mr. Dorr of the Huasteca Petroleum Company, considers that the differences are not sufficient to warrant the splitting of these brown shales into two formations. However, the author feels that until more field evidence is offered, it is better to distinguish one from the other as the two can be recognized faunally, although lithologically they are very similar.

GENERAL AGE	NAME	THICKNESS	CHARACTER
Lower Oligocene	Alazan	?	See Dumble [6] and Vaughan [7]
Eocene	Chapapote	40′ to 1020′±	Grey indurated clays containing *Hantkenina alabamensis* and *Globigerina mexicana*
	Guayabal	1000′±	Chocolate indurated clays and sandstones containing *Nodosaria mexicana* and *Robulus mexicanus*
	Tempoal	500′±	Grey to dark colored sandy shales and thin sandstones containing *Virgulina*, *Gyroidina* and *Nonion* abundantly
	Un-named	200′±	Globigerina shales with *Hantkenina mexicana*
	Chicontepec	? 1000′ ?	See Belt [8]

As the Guayabal contains the genus *Hantkenina* in some abundance, the inference may be drawn at once that it is either Upper Middle or Upper Eocene. The presence of a *Discocyclina* which I have referred to *D. clarki* Cushman, suggests a correlation with the Meganos group of Clark of the west coast. Cushman has reported *Eponides mexicana* (Cushman) from deposits of Claiborne age on the Gulf Coast. However, the best correlation to date has been made by two species of bryozoa which Dr. Bassler informs me are *Schizorthosecos interstitia* Lea and *Trochopora bouei* Lea. Also there is found one species of coral *Turbinolia pharetra* Lea. These forms are typically confined to the

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[6] E. T. Dumble; Calif. Acad. of Sci. Proc., vol. 8, pp. 141-144, 1918.

[7] T. W. Vaughan; Bull. Geol. Soc. of Amer., vol. 35, No. 4, pp. 731-732, 1924.

[8] Ben Belt; Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 1, p. 142, 1925.

Upper Claiborne and Lower Jackson. I am inclined to consider the Guayabal as Claiborne in age rather than Jackson as the presence of these forms and of *D. clarki* and *Eponides mexicana* seem to warrant this conclusion.

In a future paper, I hope to describe a few mollusks found in the Guayabal and by means of these to obtain a more definite and accurate correlation.

CONCLUSIONS

The Guayabal may be recognized both by lithology and faunal characters as a separate and distinct formation of probable Upper Claiborne age. There is a close faunal connection evidently between the Guayabal and the underlying Tempoal, but the writer believes that the two formations are separate and distinct. However, should more field work prove that the relationship is more definite, the name Tempoal must take precedence for the middle Eocene formations.

Until the time comes when more is known of the Mexican Eocene section, the above suggested classification may be adhered to as the best that can be presented with the limited knowledge we now have.

There can be no question as to the Chapapote being a separate formation as the faunal and lithologic break is sharp with the underlying Guayabal. However, the Chapapote represents probably a deep water phase[9] of the Tantoyuca. As such, it deserves a separate name to designate it.

DESCRIPTION OF SPECIES

Family AMMODISCIDÆ

Genus AMMODISCUS Reuss, 1861

Ammodiscus incertus (d'Orbigny) Pl. 4, fig. 17.

Operculina incertus d'Orbigny, Foram. Cuba, p. 71, pl. 6, figs. 16, 17, 1839.
Ammodiscus incertus H. B. Brady, Rept. Challenger, Zool., vol. 9, p. 330, pl. 38, figs. 1-3, 1884.
Ammodiscus incertus Plummer, Bull. Univ. Texas, No. 2644, pp. 63-64, pl. 13, figs. 1a-d, 1926.

[9] Personal communication from Mr. J. B. Dorr.

Specimens of this species are very rarely encountered in the Guayabal. The specimens are distorted generally. Mrs. Plummer in her discussion of Midway Foraminifera found also that the majority of her specimens had suffered distortion. This species is more common in the Chapapote beds where more perfect and typical specimens are found.

Family LITUOLIDÆ

Subfamily HAPLOPHRAGMIINÆ

Genus TROCHAMMINOIDES Cushman, 1910

Trochamminoides guayabalensis n. sp. Pl. 4, fig. 14.

Test compressed, close-coiled, inequilateral, about five chambers in the last formed coil; sutures distinct; wall finely arenaceous, smoothly finished.

Diameter 0.42 mm. Thickness 0.13 mm.

This species is related very closely to *Trochamminoides velascoensis* Cushman, but differs in having fewer chambers and a more compressed form. It is difficult sometimes to tell these two species apart. However, from the study of a great number of both, I believe the Guayabal species is distinct. *T. guayabalensis* has a very long range in the Tertiaries of Mexico.

Family TEXTULARIIDÆ

Subfamily SPIROPLECTAMMININÆ

Genus TEXTULARIA DeFrance, 1824

Textularia mexicana n. sp. Pl. 5, fig. 3.

Test small, elongate, thickest in the middle, thence thinning gradually to the periphery; well preserved specimens with a slight keel; chambers wider than high, finely arenaceous, smooth; sutures distinct, covered by a coarse, arenaceous layer which joins in the center, forming a prominent ridge.

Length 0.25-0.50 mm.

This is a small but constant and characteristic species. The coarse layers forming the ridge and covering the sutures are generally black in color. By this character, this species is distinguished easily.

Genus VULVULINA d'Orbigny, 1826

Vulvulina cf. spinosa Cushman Pl. 1, fig. 10.

Vulvulina spinosa Cushman, Cont. Cushman Lab. Foram. Res., vol. 3, No. 2, p. 3, pl. 23, fig. 1, 1927.

One specimen which may be this species, was found in the top sample from the Guayabal type locality. Only one chamber of the uni-serial portion is present. The initial chambers resemble those of Cushman's species very closely. There are young specimens of *V. spinosa* in the formation above which agree very closely with this one.

V. spinosa is a relatively common form in the Chapapote formation, but very rare in the Guayabal.

Family VERNEUILINIDÆ

Genus VERNEUILINA d'Orbigny, 1840

Verneuilina palmeræ n. sp. Pl. 2, fig. 31.

Test pyramidal, roughly three-sided, the sides convex; tri-serial throughout; coarsely arenaceous, but only slightly roughened; chambers inflated; aperture a curved slit at the base of the last chamber.

Length 0.70 mm.

This is a very rare species, occurring in only one sample. It is named in honor of Dr. Katherine V. W. Palmer.

Verneuilina aff. triquetra (Munster) Pl. 4, fig. 18.

Textularia triquetra Münster, Neues Jahrb., p. 384, pl. 3, fig. 19, 1838.

Verneuilina triquetra H. B. Brady, Rept. Challenger, Zool., vol. 9, p. 383, pl. 47, figs. 18-20, 1884.

Verneuilina triquetra Chapman, Pal. Bull. 11, New Zeal. Geol. Sur. p. 31, pl. 6, fig. 13, 1926.

A few specimens which I have placed with hesitancy under this species occur in the Guayabal. It is a very rare form.

Genus GAUDRYINA d'Orbigny, 1839

Gaudryina gaudryinoides (Fornasini) Pl. 2, fig. 30.

Clavulina gaudryinoides Fornasini, Bull. Soc. Geol. Ital., vol. 4, p. 7, tav. 6, figs. 3-9, 1885.

Clavulina gaudryinoides Halkyard, Mem. Proc. Manchester Lit. Phil. Soc., vol. 62, No. 6, p. 46, pl. 3, figs. 1-3, 1919.

Specimens taken from the top sample agree in every detail with Halkyard's figures. Therefore, I am referring my specimens to the same species. There are other forms which exhibit more strongly the bi-serial character, but it is evident that they should all be considered under the same species as there are all gradations.

Genus CLAVULINA d'Orbigny, 1826

Clavulina guayabalensis n. sp. Pl. 1, fig. 11.

Test elongate, triangular in section, slightly tricarinate; tri-serial portion short, expanding rapidly to form the uni-serial portion, the sides of which are parallel; uni-serial portion composed of three to five chambers; wall composed of relatively coarse sand grains with a large amount of cement, giving a smooth finish to the test; sutures in most specimens very indistinct; aperture terminal, round.

Length 1.1 mm.

This species is relatively common in the bottom samples from the type locality. It is close to *C. angularis* d'Orbigny, but differs in several respects.

Family MILIOLIDÆ

Genus QUINQUELOCULINA d'Orbigny, 1826

Quinqueloculina hermosa n. sp. Pl. 2, figs. 28, 29.

Test elongate, oval; chambers narrow, of uniform width; periphery rounded; aperture produced, rounded with a simple tooth; sutures distinct, surface smooth, polished.

Length 0.40-0.60 mm.

A rare species of small value because of its rarity.

Genus PYRGO DeFrance, 1824

Pyrgo sp. Pl. 4, fig. 15.

A single species is here figured for future reference. Without a more complete suite it is hopeless to place this specifically.

Family LAGENIDÆ

Subfamily NODOSARIINÆ

Genus LENTICULINA Lamarck, 1804

Lenticulina guayabalensis n. sp. Pl. 1, figs. 3, 4.

Test closely coiled in young specimens; in the adult, a portion of the central area becomes visible due to the shortening of the final chambers which fail to cover the preceding volution entirely; sutures distinct, between the last formed chambers, generally depressed slightly; 9-11 chambers in the final coil; periphery relatively sharp; central area with a knob of clear shell material; aperture produced, radiate.

Diameter 0.50-0.75 mm.

Lenticulina theta n. sp. Pl. 1, fig. 17.

Test closely coiled, composed of 6-8 chambers which gradually increase in size; sutures slightly limbate, curved, flush with the surface of the shell; periphery subangulate, not keeled; apertural face produced, triangular, tapering toward the apertural which is slightly produced, radiate.

Diameter 0.50-0.66 mm.

Genus MARGINULINA d'Orbigny, 1826

Marginulina subbullata Hantken Pl. 5, fig. 10.

Marginulina subbullata Hantken, A. Magy. Kir. foldt. int. Evkon., vol. 4, p. 39, pl. 4, figs. 9, 10, pl. 5, fig. 9, 1875 (1876).

Marginulina subbullata Cushman, Calif. Acad. of Sci. Proc., 4th ser., vol. 16, No. 8, p. 216, pl. 13, fig. 11, 1927.

In the Guayabal, only one specimen was found which may be referred to this species. It is very similar to the form found in the Alazan and Chapapote referred by Cushman to Hantken species. In Mexico it is not common in any formation.

Genus DENTALINA d'Orbigny, 1826

Dentalina cucarensis n. sp. Pl. 3, fig. 14.

Test elongate, arcuate; chambers gradually enlarging, inflated; sutures oblique, of clear shell material, depressed; apertural terminal radiate.

Length 0.81 mm.

Dentalina pulchrella n. sp. Pl. 3, fig. 1.

Test small, curved, composed of about 6 rapidly enlarging chambers, the last two comprising over half the test; wall thin, smooth, clear; sutures becoming more depressed toward the apertural end; aperture small, terminal, round, radiate.

Length 0.56 mm.

Genus NODOSARIA Lamarck, 1812

Nodosaria consobrina d'Orbigny Pl. 3, fig. 5.

Dentalina consobrina (d'Orbigny), Foram. Foss. Bass. Tert. Vienne, p. 46, pl. 2, figs. 1-3, 1846.

Nodosaria consobrina Cushman and Hanna, Trans. San Diego Soc. Nat. Hist., vol. 5, No. 4, p. 52, pl. 4, figs. 7, 8, 1927.

In the bottom samples from the type locality this form is abundant. It is easily recognized by its smooth, inflated chambers and initial spine. It is a short-ranged species. It has also been recorded from the Eocene at Coalinga and San Diego, California. Perfect specimens are seldom found, due to the ease with which this form breaks at the sutures.

Nodosaria cocoaensis Cushman var. **mexicana** n. var. Pl. 3, fig. 9.

Test differing from the original in the greater size and slightly different apertural end which is not so produced.

Length up to 4.5 mm.

This may represent a new species, but not enough differences were observed to warrant it being so considered. Except for the differences noted above, this species agrees with Cushman's figures and description of general shape, character of shell material and sutures. The megalospheric form of this species has a large subglobular, initial chamber with a small spine. Otherwise, it is like the microspheric form. *N. cocoaensis* occurs in the Alazan but may be distinguished easily from the Guayabal variety.

Nodosaria cf. N. granti Plummer Pl. 3, fig. 15.

Nodosaria granti Plummer, Bull. Univ. Texas, No. 2644, p. 77, pl. 4, figs. 9a-b, 1926.

Test similar to *Nodosaria granti* but without the initial spine. Only one specimen was found. Therefore, the variation which Mrs. Plummer speaks of could not be observed.

As it agrees better with this species, I am placing it there temporarily until more material can be studied.

Nodosaria harrisi n. sp. Pl. 3, fig. 2.

Test elongate, slender, somewhat arcuate, composed of 7-10 subglobular chambers which gradually increase in size after the first three; sutures compressed, composed of clearer shell material; shell generally brown in color, smooth, glistening; aperture terminal, phialine.

Length 0.74 mm.

This species is sparingly present. In the other Mexican Tertiary formations, there are specimens very close to this species. It probably has a very extended vertical range. Evidently it is related closely to *Nodosaria jacksonensis* Cushman and Applin. It differs from this species in the initial chambers mainly and also in size. For stratigraphic reasons, I have made this a new species as there is a form in the beds above the Guayabal, which agrees more closely with the true *N. jacksonensis*. This species is named in honor of Professor G. D. Harris.

Nodosaria mexicana Cushman Pl. 3, figs. 3, 4.

Nodosaria mexicana Cushman, Cont. Cushman Lab. Foram. Res., vol. 1, pt. 1, p. 5, pl. 1, fig. 3, 4, 1925.

Cushman's figures and description of this species, represent evidently broken specimens, as the adult form adds from three to five large, rounding chambers after the ridged ones. While most of the specimens compare exactly with his figures and discussion, a few well developed and adult forms may be found, which have the final chambers.

This species is listed as coming from the Tantoyuca formation. If it occurs in this formation, it is either very rare or is due to contamination with re-worked material. With *Robulus mexicanus*, this species is the most abundant and characteristic of the Guayabal formation.

Nodosaria oolinata n. sp. Pl. 3, fig. 16.

Test slender, elongate, arcuate, composed of numerous gradually enlarging, slightly inflated chambers; sutures distinct, depressed, of clear shell material; chambers ornamented by having a few, very indistinct, spinous processes on the posterior side; aperture very slightly produced.

Length 0.70 mm.

Nodosaria wegemanni n. sp. Pl. 3, fig. 8.

Test long, slender, slightly arcuate, gradually enlarging; chambers 10-12 in number, slightly inflated, ornamented by fine but distinctive costæ that follow the entire length of the test; sutures moderately constricted toward the apertural end, very slightly, if at all constricted between the initial chamber; aperture not observed.

Length up to 2 mm.

This is a rare species, only a few specimens being found in the upper sample. It is named in honor of Mr. Carroll H. Wegemann, chief geologist of the Pan-American Petroleum and Transport Company.

Nodosaria sp. Pl. 3, fig. 17.

In the middle sample, there was found a specimen of a *Nodosaria* showing four chambers. I am figuring it in the hope that more specimens may become available, so that it can be described specifically.

Nodosaria sp. Pl. 1, fig. 21.

This is a broken specimen, showing the last four chambers. It occurred in the upper sample from the type locality. Without a complete specimen or more fragments, this cannot be placed specifically.

Genus GLANDULINA d'Orbigny, 1826

Glandulina radicula (Linnæus) Pl. 3, fig. 6, 7.

Nautilus radicula Linnæus, Syst. Nat., 12th ed., pp. 285, 1164, 1767; Gmelin's ed. 13, vol. 1, pt. 6, p. 3373, No. 18, 1788.

Nodosaria radicula d'Orbigny, Ann. Sci. Nat., vol. 7, p. 252, No. 3, Modele No. 1, 1826.

Nodosaria radicula Cushman, Bull. U. S. Nat. Mus., No. 100, vol. 4, p. 190, pl. 34, fig. 4, 1919.

Nodosaria radicula Plummer, Bull. Univ. Texas, No. 2644, p. 77, pl. 4, figs. 9a, b, 1926.

The Guayabal forms seem very typical of this species. There seems to be considerable range as to the amount of constriction the sutures may take. On some specimens, there is little or no constriction of sutures toward the apertural end. On others, it is very marked, particularly in the final suture.

Genus ROBULUS Montfort, 1808

Robulus alato-limbatus (Gumbel) Pl. 4, fig. 1.

Robulina alato-limbata Gumbel, Abhandl. Kon. Bay. Akad. Wiss., Munchen, Cl. 2, vol. 10, p. 641, pl. 2, figs. 70a, b, (1868 [1870]).
Cristellaria alato-limbata Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 9, pp. 171, 172, pl. 8, figs. 8a, b, 1926.

Numerous specimens which resemble very closely Gumbel's species from the Eocene of Europe are found throughout the Guayabal. It is a very common form with a long range, probably extending into the formations above.

Robulus articulatus (Reuss) Pl. 1, fig. 18.

Robulina articulata Reuss, Sitz, Akad. Wiss., Wien, vol. 48, p. 53, pl. 5, fig. 62, 1863.
Cristellaria articulata H. B. Brady, Rept. Challenger, Zool., vol. 9, p. 547, pl. 69, figs. 10-12, 1884.

The Guayabal specimens appear similar to the figures and descriptions generally given for this species. While it is comparatively large and easily recognized, it is rare at all horizons.

Robulus mexicanus (Cushman) Pl. 1, fig. 20.

Cristellaria mexicana Cushman, Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, p. 299, pl. 7, fig. 1, 2, March, April, 1925.
Robulus mexicanus (Cushman), Jour. of Pal., vol. 1, No. 2, p. 151, pl. 23, fig. 8, 1927.

This species is particularly well developed, being one of the most abundant and characteristic of the formation, especially in the upper and middle parts of the well-sections. Numerous specimens were compared not only with Cushman's description and plates, but also with actual specimens from the *Operculina oliveri* zone of the Moctezuma river. In all cases, they appear to be similar.

The variety *R. mexicanus nudicostatus* Cushman and Hanna described from the Eocene of California occurs commonly at all horizons. There are, however, all gradations in this species. One form of *R. mexicanus* is very uncoiled, typically exhibiting three to five chambers in the uncoiled portion. All of these forms are confined typically to the Guayabal, but *R. m. nudicostatus* extends into the Tempoal.

Robulus pseudovortex n. sp. Pl. 1, fig. 12.

Test close-coiled, biconvex, umbonate, 6 chambers composing the last formed coil; chambers elongate, curved, enlarging as they approach the periphery; sutures raised, whirling out from the center umbo; peripheral margin acute, but not carinate; last septal face small, triangular, the aperture taking up most of the face.

Diameter 0.70 mm.

While this species adopted a very similar form of coiling to that of *R. vortex,* it can be recognized by its fewer chambers which are very much enlarged upon reaching the periphery.

Robulus pseudocultratus, n. sp. Pl. 1, fig. 5.

Test relatively small, closely coiled, with a wide, clear keel, eight chambers forming the final volution; sutures distinct, of clear shell material, widening as they approach the keel, generally flush with the surface of the test; umbilical area relatively large, filled with clear shell material; aperture radiate.

Diameter 0.58 mm.

This species belongs to the general group of specimens referred to *C. cultrata,* but differs from that in its much smaller size, less raised sutures, and larger, more distinct umbilical area. It is rare at all horizons.

Genus LINGULINA d'Orbigny, 1826

Lingulina mexicana n. sp. Pl. 1, fig. 9.

Test broadly ovate, nearly as broad as long, composed of about five chambers, the last making at least half of the individual; sutures indistinct; shell thick, highly polished; aperture elongate, terminal, enclosed by two rather prominent lips.

Length 0.63 mm. Width 0.59 mm. Thickness 0.33 mm.

This is a rare species. It has no stratigraphic value on account of its rarity.

Genus HEMICRISTELLARIA Stache, 1864

Hemicristellaria subaculeata (Cushman), var. **glabrata** (Cushman)

Cristellaria subaculeata Cushman, var. *glabrata* Cushman, Bull. U. S. Nat. Mus., No. 104, pt. 4, p. 124, pl. 32, fig. 4, pl. 33, figs. 2, 3, pl. 34, fig. 3, 1923.

Cristellaria subaculeata Cushman, var. *glabrata* Cushman and Hanna, Calif. Acad. of Sci. Proc., vol. 16, No. 8, p. 219, 1927.

Specimens that agree very closely with this variety occur sparingly in the Guayabal. The only difference noted was that the Guayabal variety does not have as strong a development of spines on the periphery.

This form may be a new variety but as there is so much variation in this type of foraminifera, it was considered best to refer it to the described form, noting the differences.

Cushman has found what he considers is this form near Coalinga, California. There, it was associated with the typical form for the species. The typical form does not seem to occur in the Guayabal.

Genus VAGINULINA d'Orbigny, 1826

Vaginulina costifera n. sp. Pl. 2, fig. 16.

Test relatively small, flattened, curved initially, keeled, strongly costate; costæ twelve in number, running the entire length of the test; sutures very indistinct; about three chambers making up the linear portion; aperture produced, radiate.

Length 0.80 mm.

This is a striking species, occurring rarely in the samples from the middle of the type outcrop.

Vaginulina legumen (Linnæus), var. **elegans** d'Orbigny
Pl. 3, figs. 10, 11.

Vaginulina elegans d'Orbigny, Ann. Sci. Nat., vol. 7, p. 257.
Vaginulina legumen (Linnæus) var. *elegans* Fornasini, Bull. Soc. Geol. Ital., vol. 5, p. 25, pl. 1, figs. 1(?), 2, 8, 1886.
Vaginulina legumen (Linnæus), var. *elegans* Cushman, Bull. U. S. Nat. Mus., No. 100, vol. 4, p. 258, pl. 41, fig. 4, 1919.

Inasmuch as the original figure was not available, I am referring the Guayabal specimens to this type, provisionally. It agrees very closely with both Cushman's Vicksburg figure and Mrs. Plummer's Midway.

It occurred in both the lower and middle samples from the type locality, but was very rare.

Vaginulina wrighti n. sp. Pl. 3, fig. 13.

Test slightly compressed laterally, composed of about eight chambers; sutures distinct, oblique; wall smooth, polished; chambers gradually enlarging, aperture produced.

Length 0.58 mm.

This is a very rare species and is named in honor of Dr. Albert H. Wright.

Family POLYMORPHINÆ

Subfamily POLYMORPHININÆ

Genus POLYMORPHINA d'Orbigny, 1826

Polymorphina communis d'Orbigny Pl. 1, fig. 6.

Polymorphina (Guttulina) *communis d'Orbigny*, Ann. Sci. Nat., vol. 7, p. 266, No. 15, pl. 12, figs. 1-4, 1826.
Polymorphina communis d'Orbigny, Foram. Foss. Bass. Tert. Vienne, p. 224, pl. 13, figs. 6-8, 1846.
Polymorphina communis Plummer, Bull. Univ. Texas, No. 2644, pp. 123-124, pl. 6, figs. 12a, b, 1926.

This species from the Guayabal is very similar to figures generally given for this type of *Polymorphina*. It is a rather common species in the bottom samples from the type locality, but occurs rarely in the others.

Genus GLOBULINA d'Orbigny, 1826

Globulina gibba d'Orbigny Pl. 4, fig. 16.

Polymorphina subcordiformia vel *oviformia* Soldani, Testaceographiae, vol. 1, pt. 2, p. 114, pl. 113, fig. 22, C. etc. 1791.
Polymorphina (*Globulina*) *gibba* d'Orbigny, Ann. Sci. Nat., vol. 7, p. 266, No. 20, Modele No. 63, 1826.

Globulina gibba d'Orbigny, Foram. Foss. Bass. Tert. Vienne, p. 227, pl. 13, figs. 13, 14, 1846.
Polymorphina gibba Cushman, Bull. U. S. Nat. Mus. No. 104, pt. 4, p. 150, 1923.

Occasionally, specimens are found which may be referred to this species. They are very rare and probably of no stratigraphic importance.

Genus GUTTULINA d'Orbigny, 1826

Guttulina problema d'Orbigny Pl. 4, fig. 20.

Polymorphina (Guttulina) problema d'Orbigny, Ann. Sci. Nat., vol. 7, p. 266, No. 14, Modeles No. 61, 1826.
Polymorphina problema Cushman, U. S. Geol. Survey, Prof. Paper, No. 133, p. 33, pl. 5, fig. 6, 1923.

Specimens that agree in every respect with d'Orbigny's figures and also those given for recent forms, were found in the middle sample from the Guayabal locality. It is a very rare form and therefore of no importance.

Family NONIONIDÆ

Genus NONION Montfort, 1808

Nonion micrus n. sp. Pl. 5, fig. 12.

Test small, compressed, strongly umbilicate, slightly lobate; sutures depressed, 6-8 chambers composing the last formed coil; shell wall very thin, rather coarsely perforate; aperture at the base of the last chamber, large.

Diameter 0.2-0.3 mm. Thickness 0.1 mm.

This small *Nonion* occurs rather frequently at all horizons in the Guayabal. It ranges also into the Chapapote. Its compressed, thin walled lobate chambers make it easy to recognize.

Nonion florinensis n. sp. Pl. 4, fig. 4.

Test small, compressed, considerably longer than wide, composed of nine chambers in the last formed volution; sutures distinct, evenly curved; periphery broadly rounded; umbilical area often exposed showing the inner ends of the earlier chambers; wall smooth; aperture a small arched opening at the base of the last septal face.

Diameter 0.21 mm. Thickness 0.10 mm.

This small species occurs frequently associated with the other two species of *Nonion*. It is very similar to *Nonion hantkeni* (Cushman and Applin) from the Upper Eocene of Texas but differs in having a constantly, smaller number of chambers and different shape. As far as is known, this species is restricted to the Guayabal.

Nonion turgidus (Williamson) var. **mexicanus** n. var. Pl. 2, fig. 12.

The variety differs from the original in the less embracing character of the last chamber, and the last septal face being not so large as in the typical *turgidus*.

Length 0.25-0.35 mm.

The Mexican species are very close, but should be separated from the original.

Nonion cf. umbilicatulus (Montagu) var. Pl. 5, fig. 6.

Nautilus umbilicatulus Montagu, Test. Brit., p. 191, 1803.

Occasional specimens of *Nonion* are found in the Guayabal samples which I am referring to this species until more work is done to separate the various specimens which are considered *N. umbilicatulus*.

Family NUMMULITIDÆ

Genus OPERCULINA d'Orbigny, 1826

Operculina cushmani n. sp. Pl. 2, fig. 14.

Test complanate, compressed, composed usually of about three coils, the last with twenty to twenty-two chambers which are very long and narrow; sutures very slightly raised with a tendency to bead, especially near the center, gently curved, meeting in the center on some specimens to form a very slight umbo which is never very prominent.

Length 2.5 mm.

Of the described *Operculinas*, its nearest representative is *O. ocalana*. It differs from this in its smaller size, less raised sutures and un-thickened periphery.

Operculina bartschi Cushman, var. **plana** Cushman Pl. 2, fig. 21.

Operculina bartschi Cushman, var. *plana* Cushman, Carnegie Inst., vol. 21, p. 50, pl. 17, figs. 5, 6, 1924.

This form is identical with the recent species described by Cushman. This is the first record of this *Operculina* in the fossil state. It is rare in its occurrence and of small value as a horizon marker.

Family HETEROHELICIDÆ

Subfamily PLECTOFRONDICULARINÆ

Genus PLECTOFRONDICULARIA Liebus, 1903

Plectofrondicularia mexicana Cushman

> *Plectofrondicularia mexicana* (Cushman), Cont. Cushman's Lab. Foram. Res., vol. 1, pt. 4, p. 88, pl. 13, figs. 5a-c, 1926.

This is a beautiful species, occurring most abundantly in the sample from the middle zone of the type locality with *Hantkenina longispina* Cushman.

Plectofrondicularia sp. Pl. 2, fig. 10

Specimens referable to this genus, occur sparingly in the middle sample from the type locality As a complete specimen was not found, it was considered better not to place this form specifically. It is here figured for future reference.

Family HANTKENINIDÆ

Genus HANTKENINA Cushman, 1924

Hantkenina longispina Cushman Pl. 4, fig. 7.

> *Hantkenina longispina* Cushman, Proc. U. S. Nat. Mus., vol. 66, p. 2, pl. 2, fig. 4, 1924.
> *Hantkenina longispina* Cushman, Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, March-April, p. 299, pl. 7, fig. 3, 1925.

In the sample taken at the middle horizon at the type outcrop, this species occurs relatively abundant. In view of the fact of its comparative rarity, in all the samples examined, and its fragility, it is valueless as a marker in well sections.

Family BULIMINIDÆ

Subfamily BULIMININÆ

Genus BULIMINA d'Orbigny, 1826

Bulimina guayabalensis n. sp. Pl. 1, figs. 1, 2.

Test compact, ovate, broadest near the apertural end, chambers few, large, inflated, smooth; sutures strongly depressed aperturally, very slightly depressed in the initial chambers; aperture long, narrow.

Length 0.42 mm. Width 0.26 mm.

Cushman has figured already this species under *Bulimina* sp. in his Moctezuma paper and also a species very similar to this, in his discussion of the Texas Jackson Foraminifera. It belongs to the general group of *Bulimina pupoides* d'Orbigny, but differs in the fewer number of chambers, more compact form and slightly different arrangement of chambers.

Bulimina inflata Seguenza Pl. 3, fig. 12.

Bulmina inflata Seguenza, Atti. Accad. Givenia Sci. Nat., ser. 2, vol. 18, p. 109, pl. I, fig. 10.
Bulimina inflata H. B. Brady, Rept. Challenger, Zool., vol. 9, p. 406, pl. 51, figs. 10-13, 1884.
Bulimina inflata Cushman, Bull. U. S. Nat. Mus., No. 100, vol. 4, p. 160, pl. 31, fig. 6, 1921.

There are specimens from the Guayabal which are very similar in shape and ornamentation to that of Seguenza's. For the present, it is considered better to refer it to this species.

Subfamily VIRGULININÆ

Genus VIRGULINA d'Orbigny, 1826

Virgulina mexicana n. sp. Pl. 5, fig. 14.

Test small, compressed, axis slightly twisted; tri-serial portion very short; bi-serial chambers elongate, bolivine; sutures distinct, slightly depressed; wall smooth, very finely perforate; aperture comma shaped at the end of the last chamber.

Length 0.30-0.55 mm.

This species is very close, if not identical with one Cushman figured in his Byram marl paper as *Virgulina sp.* It is characteristic of both the Guayabal and Tempoal, but its range is restricted to these formations. At some horizons it is very abundant.

Genus BOLIVINA d'Orbigny, 1839

Bolivina gracilis Cushman and Applin Pl. 5, fig. 13.

Bolivina gracilis Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, p. 167, pl. 7, figs. 1, 2, 1926.

There are small specimens of *Bolivina* in the Guayabal, that compare closely with Cushman's and Applin's description and figures. I am referring my specimens to this species with some hesitancy. They occur rarely and are easily overlooked. The best specimens came from the bottom sample from the Guayabal locality.

Genus PROROPORUS Ehrenberg, 1844

Proroporus mexicanus n. sp. Pl. 1, fig. 19.

Test elongate, triangular, thickest in the middle, thinning evenly to the periphery, which is serrate, the serrations being in the shape of a thin keel which is indented at each suture; sutures distinct, depressed, the chamber wall between the sutures being white and raised; aperture terminal, large.

Length 0.93 mm.

This is a rare but peculiar species from the top sample at the type locality.

Subfamily UVIGERININÆ

Genus UVIGERINA d'Orbigny, 1826

Uvigerina blanca-costata n. sp. Pl. 2, fig. 11.

Test relatively small, later portion with the chambers somewhat loosely arranged, periphery in this portion, lobulate; chambers few, inflated, especially the later ones; wall ornamented with longitudinal costæ, the costæ not confluent with those on the chambers above or below; in the early portion there is the tendency of the costæ to break into spines; aperture a tapering, cylindrical neck.

Length 0.33 mm.

This is a relatively rare form.

Uvigerina elongata n. sp. Pl. 4, figs. 3, 4.

Test small, elongate, composed of a compact, early portion, with a tendency for the final chamber to be added uni-serially; surface slightly hispid; aperture an elongate neck and with a narrow, rimmed phialine neck.

Length 0.35-0.40 mm.

This species is nearest *Uvigerina ampullacea* H. B. Brady, but differs in having the uni-serial portion not so strongly developed and not as strongly hispid. It is also much smaller in size and has a shorter neck.

Uvigerina gladysæ n. sp. Pl. 5, fig. 11.

Test minute, about as broad as long, apertural end the largest; chambers few, strongly inflated; sutures distinct; the initial chambers having 3-5 short spines, test otherwise without ornamentation; aperture circular on the end of a short neck.

Length 0.15 mm.

It is fairly common in most samples but easily overlooked on account of its small size.

Uvigerina pigmea d'Orbigny Pl. 5, fig. 9.

Uvigerina pigmea d'Orbigny, Ann. Sci. Nat. vol. 7, p. 269, pl. 12, figs. 8, 9, 1826.

Uvigerina pygmaea d'Orbigny, Foram. Foss. Bass. Tert. Vienne, p. 190, pl. 11, figs. 25, 26, 1846.

Specimens that are similar in type to the figures given in the Vienna Basin monograph are found in the Guayabal samples from the type locality. No specimen from the Guayabal gives any indication of grading into the type of *U. pigmea* as represented by the figure in the Annales des Sciences Naturales, which should probably be considered a separate species.

Uvigerina rippensis n. sp. Pl. 2, fig. 17.

Test of medium size for the genus, elongate, fusiform; periphery slightly lobulate; chambers rather few, inflated, evenly rounded; sutures slightly depressed; central chambers ornamented with coarse, prominent, longitudinal costæ which break into spines on either end of the test; apertural end with a short, cylindrical neck and phialine lip.

Length 0.75 mm.

This is a very characteristic species, found only in the middle sample. It is easily recognized by the tuberculate apertural and initial ends with the coarse costæ between.

Genus ANGULOGERINA Cushman, 1927

Angulogerina gallowayi n. sp. Pl. 5, fig. 8.

Test elongate, tapering toward either end, composed of numerous chambers, three making each whorl, with the exception of the last chamber which is added uni-serially; chambers are so compressed as to make a tri-facial test; chambers smooth, perforate; some specimens having a slight keel along the angles; aperture elongate, with a phialine lip.

Length 0.2-0.4 mm.

This species is close to *Angulogerina angulosa* (Williamson), but differs in size and ornamentation. It is without doubt a distinct species and easily recognized in spite of its small form. It is abundant at some horizons, especially the middle sample from the type locality. This species is named in honor of Dr. J. J. Galloway of Columbia University.

Family ROTALIIDÆ

Subfamily DISCORBISINÆ

Genus GYROIDINA d'Orbigny, 1826

Gyroidina guayabalensis n. sp. Pl. 2, figs. 25, 26, 27.

Test plano-convex, ventral side strongly convex; 8-9 chambers forming the last volution, deeply umbilicate; sutures distinct, not raised; chambers of the last formed coil appearing very narrow on the dorsal side; a distinct depression between the last formed coil and the remaining coils on the dorsal side; aperture an elongate slit on the center of the inner edge of the last face.

Diameter 0.40 mm. Thickness 0.27 mm.

This species differs from *G. soldanii* var. *octocamerata* in its larger size, more angulated margin, flush sutures and narrower, more elongated chambers of the last coil.

Gyroidina soldanii d'Orbigny var. **octocamerata** Cushman and Hanna Pl. 2, figs. 22, 23, 24.

Gyroidina soldanii d'Orbigny var. *octocamerata* Cushman and Hanna, Calif. Acad. of Sci. Proc., 4th ser., vol. 16, No. 8, p. 223, pl. 14, fig. 16-18, 1927.

This species described from the Eocene of California is rather common in many of the Guayabal samples.

Subfamily ROTALIINÆ

Genus EPONIDES Montfort, 1808

Eponides guayabalensis n. sp. Pl. 2, figs. 18, 19, 20.

Test unequally bi-convex, composed of three and one-half coils, the ventral side more convex than the dorsal, umbilicate; periphery angulate, subcarinate, 12-14 chambers in the last volution; sutures on both dorsal and ventral side nearly straight, the ventral ones forming a ring of clear shell material around the umbilicus; aperture a low arched slit between the umbilicus and periphery.

Diameter 0.82 mm. Thickness 0.52 mm.

In general aspect, this species resembles *E. mexicana* but with its greater number of coils and chambers, together with the nearly straight, dorsal sutures and large size, it is easily recognizable. It is a characteristic and abundant form in the Guayabal and should be an excellent marker.

Eponides mexicana (Cushman) Pl. 2, figs. 6, 7, 8.

Pulvinulina mexicana Cushman, Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, p. 300, pl. 7, figs. 7, 8, 1925.

Eponides mexicana (Cushman), Jour. of Pal., vol. 1, No. 2, p. 165, pl. 26, figs. 6, 7, 1927.

Numerous specimens of the species occur, particularly in the bottom sample. It is another characteristic foraminifera confined to the Guayabal and should prove to be an excellent horizon marker.

Genus ROTALIA Lamarck, 1804.

Rotalia dorri n. sp. Pl. 4, figs. 5, 6.

Test bi-convex, umbilicate tightly coiled; ventral side more convex than the dorsal; two and one-half coils with 8-9 gradually enlarging chambers in the last formed coil;

margin rounded; aperture an arched slit on the last septal face, midway between the dorsal margin and the umbilicus.

Diameter 0.35-0.75 mm.

This is a distinct species found in great numbers in the lower sample from the type locality. It seems to be confined to the Guayabal and is an excellent marker for certain horizons. This species is named in honor of Mr. James B. Dorr, Paleontologist of the Huasteca Petroleum Company, Tampico, Mexico.

Subfamily SIPHONININÆ

Genus EPISTOMINA Terquem, 1883

Epistomina bradyi Galloway and Wissler Pl. 2, figs. 1, 2.

Pulvinulina partschiana H. B. Brady (d'Orbigny), Rept. Challenger, Zool., vol. 9, p. 699, pl. 105, fig. 3, 1884.

Epistomina bradyi Galloway and Wissler, Jour. of Pal., vol. 1, No. 1, pp. 60-61, pl. 10, fig. 1, 1927.

Several specimens of the same character as the one described by Galloway and Wissler occur in the Guayabal sample. It is not very distinctive and probably of no stratigraphic value as similar species occur in other Mexican formations. Cushman considers the specimens he has from the Alazan as *Epistomina elegans* (d'Orbigny). However, the Guayabal specimens agree more closely to Brady's and Galloway's figures, than to those usually referred to as *E. elegans*.

Genus SIPHONINA Reuss, 1849

Siphonina tenuicarinata Cushman Pl. 5, figs. 1, 2.

Siphonina tenuicarinata Cushman, Jour. of Pal., vol. 1, No. 2, pp. 166-167, pl. 26, figs. 11, 12, 1927.

The Guayabal specimens resemble the Alazan species as described by Cushman very closely. I have compared actual specimens and the only difference noted is that the wide keel is missing frequently in the Guayabal forms. Many Alazan specimens also seem to be lacking the keel. As the chambers and other features of the test remain constant and similar, I am referring the Guayabal specimens to his species. This is one of the long ranged foramininfera in the Mexican formations.

Family AMPHISTEGINIDÆ

Genus AMPHISTEGINA d'Orbigny, 1826

Amphistegina mexicana n. sp. Pl. 2, fig. 13.

Test small, lenticular or more convex on the ventral side in some specimens; 24-26 chambers composing the last formed volution which embraces all the preceding ones; sutures distinct, particularly in older specimens where they are slightly raised, straight for half their length, after which they are strongly recurved; the area near the aperture slightly papillate.

Diameter 1.06-1.60 mm.

Family CASSIDULINIDÆ

Subfamily CERATOBULIMININÆ

Genus CERATOBULIMINA Toula, 1920

Ceratobulimina declivis Reuss, var. **mexicana** Pl. 5, fig. 16.

The variety differs from the original in its more compact form, less prominent sutures and less inflated chambers.

Length 0.42 mm.

This is a very rare species in the Guayabal and as far as I know, does not occur in any other Mexican formation.

Genus PULVINULINELLA Cushman, 1926

Pulvinulinella culter (Parker and Jones), var. **mexicana** n. sp.
Pl. 1, figs. 15,-16.

The variety differs from the typical form in its larger size, narrow flange, less pronounced, ventral sutures, greater bi-convexity and very smooth, glassy, dorsal surface.

Diameter 0.75-0.95 mm.

Specimens are relatively rare, but from observations on other formations, this variety probably ranges through most of the Eocene formations in Mexico, at least up to the Alazan. It is related to *Pulvinulinella interrupta* Cushman from the Alazan and *Pulvinulinella velascoensis* (Cushman) from the Velasco. It is intermediate between these two types.

Subfamily CASSIDULININÆ

Genus CASSIDULINA d'Orbigny, 1826

Cassidulina globosa Hantken

Cassidulina globosa Hantken, A magy. kir. foldt. in. eukonyve., vol. 4, p. 54, pl. 16, fig. 2, 1875 (1876).
Cassidulina globosa Hantken, Mitth. Jahrb. ungar. geol. Anstalt., vol. 4, p. 64, pl. 16, fig. 2, 1875 (1881).
Cassidulina globosa Cushman, Jour. of Pal., vol. 1, No. 2, p. 167, pl. 26, fig. 13, 1927.

A species occurring very infrequently, may be referred to the one described by Hantken. It is a long ranged foraminifera in the Mexican formations and therefore, of no stratigraphic importance.

Cassidulina lomitensis Galloway and Wissler, var. **mexicana** n. var. Pl. 5, figs. 4, 5.

This variety differs from the typical form mainly in size and thickness. Specimens of this variety while coiling exactly as the Californian species and having the same shaped aperture, are constant in their much smaller size.

Diameter 0.21 mm. Thickness 0.11 mm.

It is a rare form in the Guayabal and easily overlooked on account of its small size.

Family CHILOSTOMELLIDÆ

Subfamily ALLOMORPHINELLINÆ

Genus PULLENIA Parker and Jones, 1862

Pullenia quinqueloba (Reuss) Pl. 5, fig. 15.

Nonionina quinqueloba Reuss, Zeitschr. deutsch. geol. Ges., vol. 3, p. 47, pl. 5, figs. 31a, b, 1851.
Pullenia quinqueloba Cushman, Bull. U S. Nat. Mus., No. 100, vol. 4, p. 299, 1921.

Small, five chambered specimens of this genus which may be referred to Reuss' species, are found very rarely in the Guayabal material.

Family GLOBIGERINIDÆ

Subfamily GLOBIGERININÆ

Genus GLOBIGERINA d'Orbigny, 1826

Globigerina apertura Cushman

Globigerina apertura Cushman, Bull. U. S. Geol. Survey, No. 676, p. 57, pl. 12, fig. 8, 1918.
Globigerina apertura Galloway and Wissler, Jour. of Pal., vol. 1, No. 1, p. 40, pl. 7, fig. 5, 1927.

Frequent specimens of *Globigerina* that resemble Cushman's species very closely, are found in the Guayabal. So far, this is the lowest record for this species.

Globigerina bakeri n. sp. Pl. 4, figs. 12, 13.

Test large, composed of four, inflated chambers in the last volution; initial chambers small, usually five in number, tightly coiled; wall coarsely punctate; one main aperture and several smaller ones opening into the shallow umbilicus.

Diameter 0.63 mm.

This large, subglobular species is one of the commonest of the *Globigerina* forms encountered in the Guayabal. It is named in honor of Mr. William Baker, Geologist of the Trans-continental Petroleum Company, Tampico, Mexico.

Globigerina orbiformis n. sp. Pl. 5, fig. 7.

Test small, spherical; sutures in most specimens very indistinct; chambers slightly if at all inflated; wall thick, reticulate; surface dull; one, main aperture at the base of the last formed chamber with several, smaller apertures.

Diameter 0.27 mm.

This small species is evidently the ancestor of *Globigerina mexicana*, found in the first eighty feet of the formation above. It differs from the latter mainly in its constantly smaller size and rougher finish.

Globigerina inflata d'Orbigny Pl. 4, fig. 19.

Globigerina inflata d'Orbigny, His. Nat. Isles Canaries., vol. 2, pt. 2, Forams. p. 134, pl. 2, figs. 7-9, 1839.

Globigerina inflata H. B. Brady, Rept. Challenger, Zool., vol. 9, p. 601, pl. 79, figs. 8-10, 1884.

Globigerina inflata Galloway and Wissler, Jour. of Pal., vol. 1, No. 1, p. 43, pl. 8, fig. 1, 1927.

One of the most common *Globigerina* in the Guayabal, may be referred to this species. It is relatively abundant at all horizons and has a long range.

Globigerina topilensis Cushman

Globigerina topilensis Cushman, Cont. Cushman Lab. Foram. Res., vol. 1, No. 1, p. 7, pl. 1, figs. 9a, b, c, 1925.

Cushman described this species from the Upper Eocene, Tantoyuca formation. It is relatively common in the Guayabal formation. Probably it occurs only rarely in the Tantoyuca, as I have never seen any specimens in that formation in the samples from the type locality of the Tantoyuca.

Globigerina wilsoni Pl. 4, figs. 8, 9.

Test slightly rotaliform, almost planospirally coiled, last volution consisting of five gradually enlarging chambers; umbilicate; wall coarsely perforate; aperture a curved slit opening into the umbilicus.

Diameter 0.24 mm.

This species is very similar to one figured by Mrs. Plummer from the Midway of Texas as *G. pseudo-bulloides*. It differs in having a less lobate periphery and in being more planospirally coiled. Due to its small size, it is often overlooked in the Guayabal. It is named in honor of Mr. John H. Wilson, Geologist of the Huasteca Petroleum Company, Tampico, Mexico.

Family GLOBOROTALIIDÆ

Genus GLOBOROTALIA Cushman, 1927

Globorotalia crassata (Cushman) Pl. 1, figs. 7, 8.

Pulvinulina crassata Cushman, Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, pp. 300-301, pl. 7, fig. 4, 1925.

This species described by Cushman, is another abundant form at the type locality of the Guayabal. Associated with it is the var. *densa*, also abundant. These forms range through the entire Guayabal and probably into the formation below the Guayabal.

Globorotalia spinulosa Cushman Pl. 2, fig. 9.

Globorotalia spinulosa Cushman, Cont. Cushman's Lab. Foram. Res., vol. 3, pt. 2, p. 114, pl. 23, figs. 4a-c, 1927.

This is a long ranged species in the Eocene of Mexico, extending from the un-named formation below the Tempoal into the Chapapote. It is constant in its characters throughout its range.

Family ANOMALINIDÆ

Subfamily ANOMALININÆ

Genus ANOMALINA d'Orbigny, 1826

Anomalina umbonata Cushman

Anomalina umbonata Cushman, Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, p. 300, pl. 7, figs. 5, 6, 1925.
Anomalina umbonata Cushman, Jour. of Pal., vol. 1, No. 2, p. 170, pl. 27, figs. 10, 11, 1927.

Specimens of this striking *Anomalina* are met with frequently in all samples. It is very true to type as described from the Moctezuma river.

Subfamily CIBICIDINÆ

Genus CIBICIDES Montfort, 1808

Cibicides conoideus Galloway and Wissler Pl. 2, figs. 3, 4, 5.
Cibicides conoideus Galloway and Wissler, Jour. of Pal., vol. 1, No. 1, pp. 63, 64, pl. 10, fig. 7, 1927.

There are specimens in the Guayabal of a small *Cibicides,* that agree almost exactly with the one described by Galloway and Wissler. The only difference is, that the Guayabal species characteristically has sixteen chambers. Until actual specimens can be compared, it is better to refer the Guayabal specimens to this species. The umbonate character of these specimens is particularly striking, as is the case with Galloway's species.

Cibicides sassei n. sp. Pl. 4, figs. 10, 11.

Test bi-convex, more strongly so on the ventral side; the final volution composed of nine, gradually enlarging chambers, the final one often inflated more than the others; periphery subangulate, subcarinate; shell coarsely perforate; a knob of clear shell material occupying the center on the ventral side; sutures distinct, of clear shell material, on the dorsal side, slightly raised as they approach the center and joining to form a mass of shell material; aperture on the periphery at the base of the last chamber and extending on to the dorsal along the suture line, between the last two whorls for a distance of one chamber.

Diameter 0.39 mm. Thickness 0.15 mm.

This is a common fossil at many horizons. It is named in honor of Mr. Jerome B. Sasse, Paleontologist of the Huasteca Petroleum Comapny, Tampico, Mexico.

Cibicides pseudowuellorstorfi n. sp. Pl. 1, figs. 13, 14.

Test plano-convex, very flat dorsally, slightly convex ventrally; last formed coil composed of 10-12 chambers; periphery very slightly lobate, bluntly angulate, slightly carinate; sutures gently curved, limbate; wall coarsely punctate; all the chambers showing dorsally, only those of the last formed whorl ventrally; the umbilical region with a large knob of clear shell material; aperture peripheral, extending on to the dorsal side.

Diameter 0.66 mm.

Dorsally, this heavy ribbed *Cibicides* resembles *C. wuellerstorfi,* but the knob of clear shell material and gently recurved sutures easily distinguish it from this species. It is a relatively common form in the Guayabal and is confined to that formation.

Family ORBITOIDIDÆ

Genus DISCOCYCLINA Gumbel, 1868

Discocyclina clarki (Cushman) Pl. 2, fig. 32.

Orthophragmina clarki Cushman, U. S. Geol. Survey, Prof. Paper, No. 125, pp. 41, 42, pl. 7, figs. 4, 5, 1919.

Except for size, this species agrees exactly with the description and figures given by Cushman. The largest specimens from the Guayabal, measures slightly under 3 mm.

It is characteristic particularly of the lower samples from the type locality where it is abundant. It occurs rarely in the other samples and apparently is short-ranged.

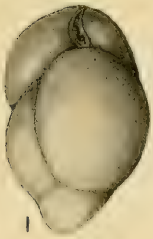
PLATES 1-5

Note.—All the holotypes described and figured in this paper have been deposited in the Eocene collection of Prof. G. D. Harris at Cornell University.

All the specimens described came from the Guayabal type locality.

PLATE 1

FIGURE		PAGE
1.	**Bulimina guayabalensis** n. sp. x 75; holotype	24
2.	**Bulimina guayabalensis** n. sp. x 75; paratype	24
3.	**Lenticulina guayabalensis** n. sp.; apertural view x 40; paratype	14
4.	**Lenticulina guayabalensis** n. sp.; side view of a larger specimen x 40; holotype	14
5.	**Robulus pseudocultratus** n. sp. x 35; holotype	19
6.	**Polymorphina communis** d'Orbigny x 45	21
7.	**Globorotalia crassata** (Cushman); dorsal view x 35	34
8.	**Globorotalia crassata** (Cushman); ventral view x 35	34
9.	**Lingulina mexicana** n. sp. x 40; holotype	19
10.	**Vulvulina cf. spinosa** Cushman x 30	12
11.	**Clavulina guayabalensis** n. sp. x 40; holotype	13
12.	**Robulus pseudovortex** n. sp. x 40; holotype	19
13.	**Cibicides pseudowuellerstorfi** n. sp.; dorsal view x 40; holotype	36
14.	**Cibicides pseudowuellerstorfi** n. sp.; view of a slightly smaller specimen x 40; paratype	36
15.	**Pulvinulinella culter** (Parker and Jones) var. **mexicana** n. var.; ventral view x 30; holotype	31
16.	**Pulvinulinella culter** (Parker and Jones) var. **mexicana** n. var.; dorsal view x 30; paratype	31
17.	**Lenticulina theta** n. sp. x 40; holotype	14
18.	**Robulus articulatus** (Reuss) x 40	18
19.	**Proroporus mexicanus** n. sp. x 40; holotype	26
20.	**Robulus mexicanus** (Cushman) x 35	18
21.	**Nodosaria** sp. x 30	17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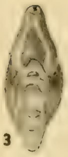
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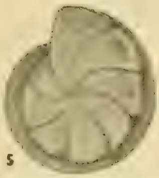
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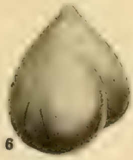
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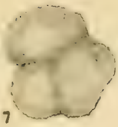
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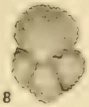
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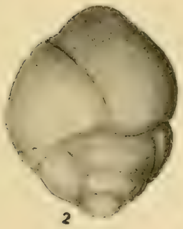
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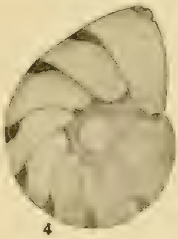
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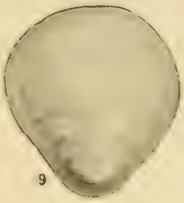
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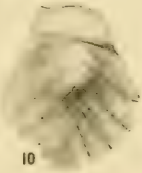
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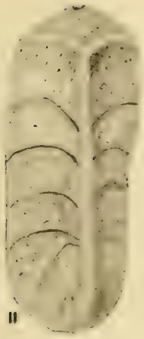
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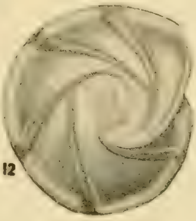
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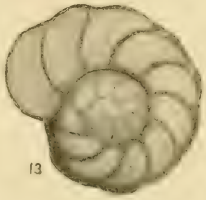
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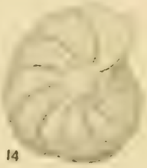
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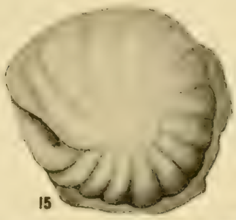
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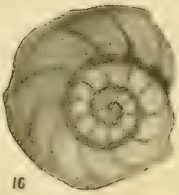
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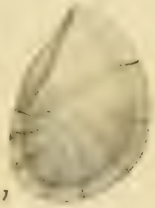
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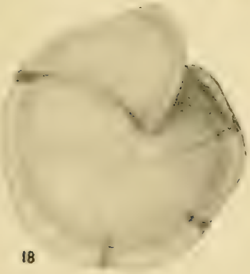
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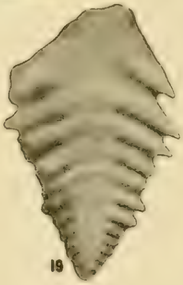
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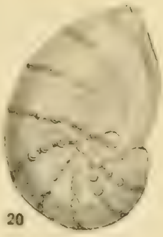
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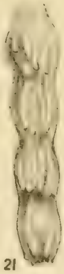
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PLATE 2

Figure		Page
1.	**Epistomina bradyi** Galloway and Wissler; ventral view x 15	30
2.	**Epistomina bradyi** Galloway and Wissler; dorsal view x 15.	30
3.	**Cibicides conoideus** Galloway and Wissler; ventral view x 35.	35
4.	**Cibicides conoideus** Galloway and Wissler; dorsal view of a larger specimen x 35	35
5.	**Cibicides conoideus** Galloway and Wissler; side view x 35.	35
6.	**Eponides mexicana** (Cushman); ventral view x 45	29
7.	**Eponides mexicana** (Cushman); side view x 45	29
8.	**Eponides mexicana** (Cushman); dorsal view x 45	29
9.	**Globorotalia spinulosa** Cushman; ventral view x 35	34
10.	**Plectofrondicularia** sp. x 23	24
11.	**Nonion turgidus** (Williamson), var. **mexicanus** n. var. x 65; holotype	23
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14.	**Uvigerina blanca-costata** n. sp. x 55; holotype	26
15.	**Vaginulina costifera** n. sp. x 32; holotype	20
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17.	**Eponides guayabalensis** n. sp.; ventral view x 25; paratype	29
18.	**Eponides guayabalensis** n. sp.; dorsal view x 25; holotype	29
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20.	**Operculina bartschi** Cushman, var. **plana** Cushman x 14	23
21.	**Gyroidina soldanii d'Orbigny,** var. **octocamerata** Cushman and G. D. Hanna; side view x 45	29
22.	**Gyroidina soldanii** d'Orbigny var. **octocamerata** Cushman and G. D. Hanna; ventral view x 45	29
23.	**Gyroidina soldanii** d'Orbigny, var. **octocamerata** Cushman and G. D. Hanna; dorsal view x 45	29
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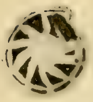
26.	**Gyroidina guayabalensis** n. sp.; dorsal view x 40; paratype.	28
27.	**Quinqueloculina hermosa** n. sp. x 47; holotype	13
28.	**Quinqueloculina hermosa** n. sp. x 47; paratype	13
29.	**Gaudryina gaudryinoides** (Fornasini) x 30	13
30.	**Verneuilina palmeræ** n. sp. x 45; holotype	12
31.	**Discocyclina clarki** (Cushman) x 14	36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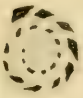
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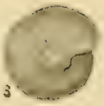
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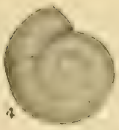
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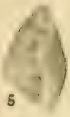
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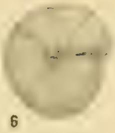
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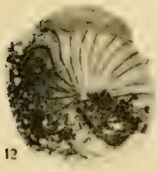
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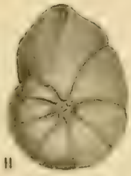
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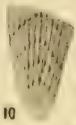
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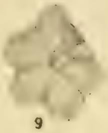
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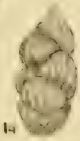
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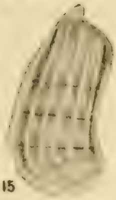
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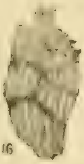
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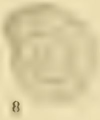
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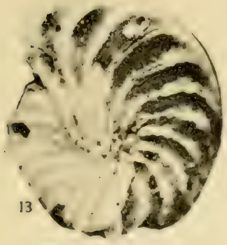
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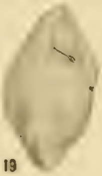
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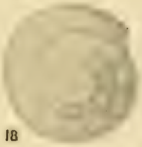
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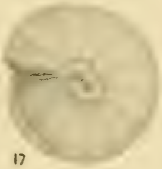
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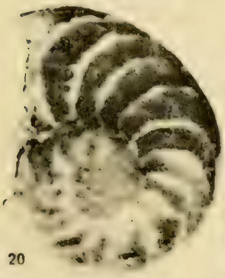
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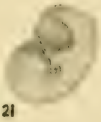
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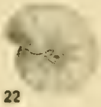
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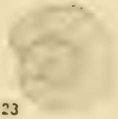
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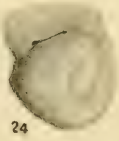
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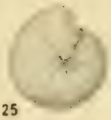
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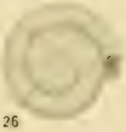
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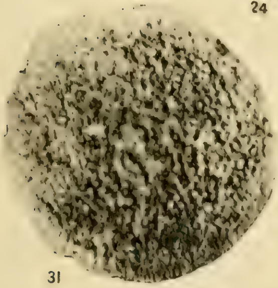
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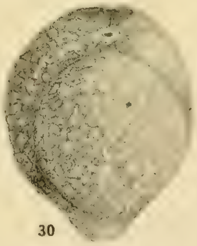
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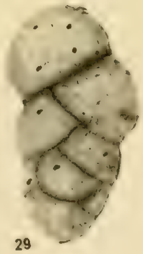
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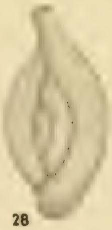
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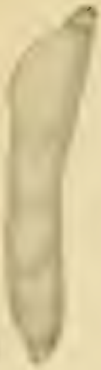
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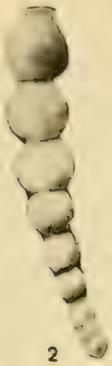
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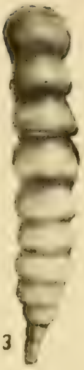
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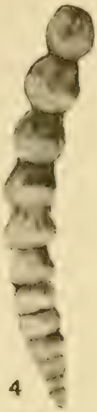
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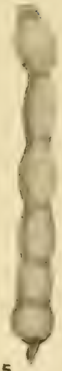
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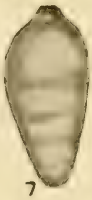
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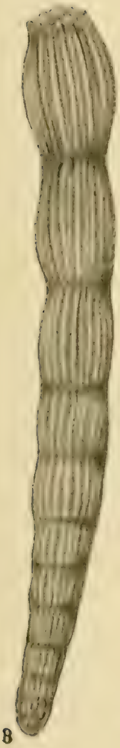
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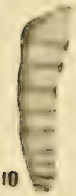
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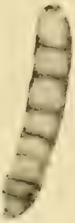
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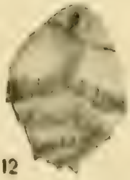
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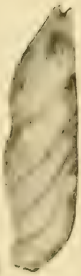
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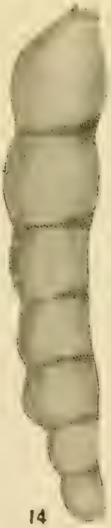
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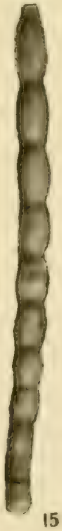
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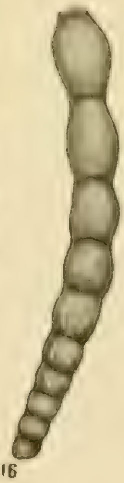
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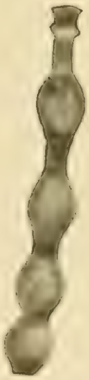
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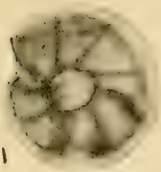
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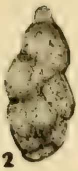
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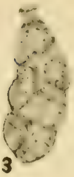
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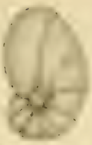
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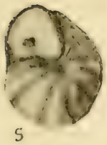
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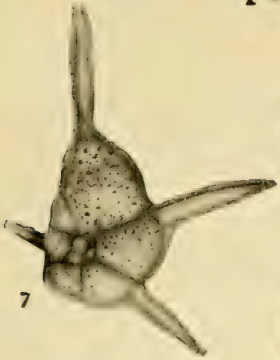
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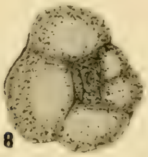
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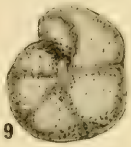
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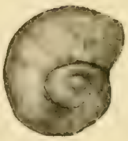
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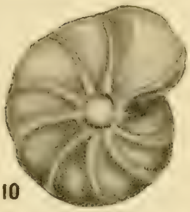
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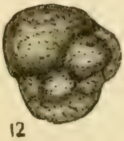
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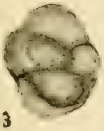
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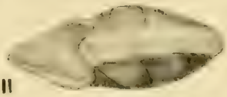
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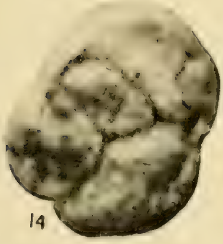
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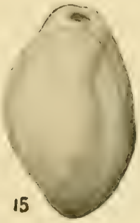
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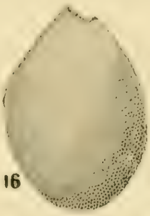
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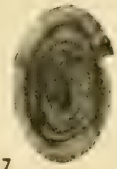
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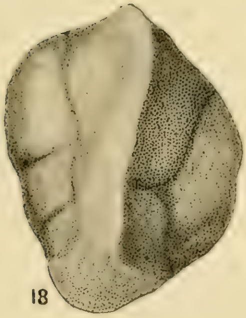
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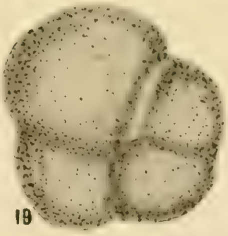
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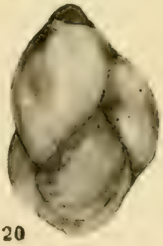
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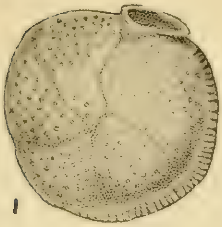
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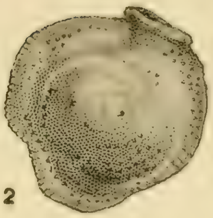
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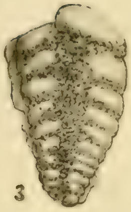
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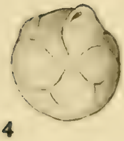
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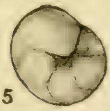
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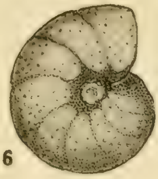
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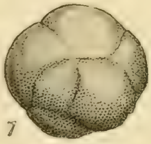
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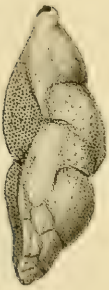
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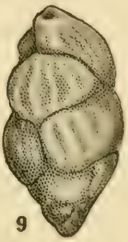
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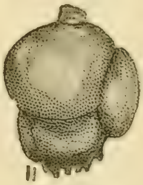
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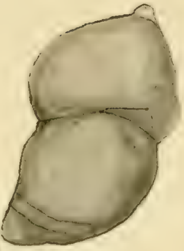
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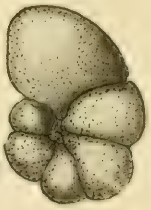
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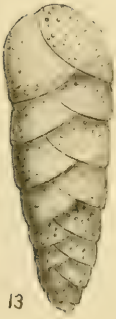
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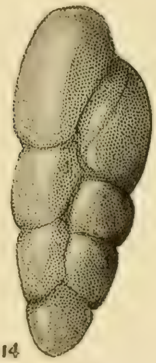
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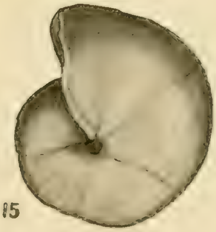
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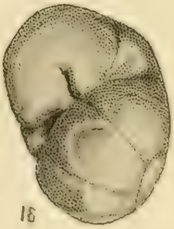
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BULLETINS
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Vol. 14

No. 52

CONTRIBUTIONS TO THE TERTIARY PALEONTOLOGY OF NORTHERN PERU:

Part I, Eocene Mollusca and Brachiopoda

By A. A. Olsson

April 19, 1928

Harris Co.
Ithaca, N.Y.
U. S. A.

PREFACE

This paper dealing with certain new or otherwise interesting Eocene mollusks is the first of a series of Contributions to the Tertiary Paleontology of Northern Peru. These studies are principally based upon fossil collections and field observations made during several years of reconnaissance and detailed geologic and stratigraphic investigations for the International Pertoleum Co. Ltd., under the direct and able supervision of its Chief Geologist Dr. O. P. Hopkins. It is also with pleasure that I acknowledge the assistance received from the other members of the Geologic staff at Negritos, namely to Mr. A. Iddings, formerly in charge of the Geologic Office in Negritos and to Messrs O. D. Boggs, G. Boughton, J. Stewart, J. L. Stauft, E. N. MacCormack, E. W. Berry, V. Culbert, and E. Emendorfer.

The geology and stratigraphy of the area has recently been described by Iddings and Olsson in an article published in the Bulletins of the American Association of Petroleum Geologists Vol. 12. No. 1. The student will find in this paper the columnar section of the Tertiary rocks of Peru and the formational names used in the description of the fossil fauna. This information is released for publication through the permission of the International Petroleum Co. Ltd.

Ithaca, N. Y.
January, 1928.

INTRODUCTION

The literature of the 19th century, dealing with the paleontology of the Tertiary rocks of northern Peru, is extremely meager and gives little or no information as to the age and character of the Tertiary deposits of the region. The first fossils to be described from this region were obtained by d'Orbigny[1] who made collections of both recent and fossil mollusks at Paita. His collections of Paita fossils consists mainly of Pleistocene shells from the Tablazo beds exposed so well along the top of the high sea-cliffs east and south of the town. The lot however included an imprint of a Rostellaroid shell which he named *Rostellaria gaudichaudi.* This species has the distinction of being the first fossil to be described from the true Tertiary rocks of Peru, and we now know that it came from certain sandstones of Upper Eocene age.

Señor A. Raimondi during his extensive geographic exploration in the Peruvian Republic had obtained large collections of fossils but principally from the older rocks. These collections were submitted to Wm. M. Gabb[2] for study and in 1869 there appeared the first of the two papers dealing with their description. In this article additional Pleistocene fossils are described from Paita along with two species from the same locality obtained by Professor Orton. Orton's shells which were named *Ampullina ortoni* and *Cerithium lævisculum* are common Upper Eocene fossils and doubtless came from the Paita Saman sandstones which previously had yielded d'Orbigny's *Rostellaria gaudichaudi.* Because of the association of living and extinct species, Gabb placed the age of the Paita fossils as Pliocene but noting the difference in enclosing matrix, he also suggested that the fossils may have come from rocks of different ages.

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[1] 1842— D'Orbigny, Alcide. Voyage dans l'Amérique Méridionale, Paléontologie at Géologie. Vol. 3, Pt. 3, 4.

[2] 1869—Gabb, W. M. Description of a new species of South American fossils. Tertiary. American Journal of Conchology. Vol. 5, Pt. 1, p. 25.
1877.—Gabb, W. M. Description of a collection of fossils made by Dr. Antonio Raimondi in Peru. Journ. Acad. Nat. Sci. Phila. new series, Vol. 8, pt. 3, p. 263.

About the same time as Gabb's article on the Paita collection, E. T. Nelson,[3] in a graduation thesis, published an account of some fossils from Zorritos. Nelson made no special age determination, other than late Tertiary as suggested by the title of his paper.

In 1889, there appeared Grzybowski's[4] account of a geologic reconnaissance from Paita to Tumbez. In this paper, there is given for the first time, a description of the Tertiary rocks of northern Peru, and an attempt at their stratigraphic subdivision. Grzybowski's paper is principally valuable for his work in the Zorritos region, definitely establishing the Miocene age of the Zorritos rocks. Owing probably to insufficient paleontologic information, he failed or erred in his intrepretation of the geology and age of relationship of the rocks at Paita and Talara.

Outside of Adams'[5] brief reconnaissance through La Brea and the Chira valley, it remained until 1920 and 21, before anything further of note was published on the Tertiary mollusks of the region. H. Douvillé[6] in a series of papers dealing with certain fossils collected at Negritos and submitted by Señor C. I. Lisson of Lima, was able to prove the occurrence of Eocene rocks in the Peruvian littoral. Several of the commonest and most characteristic of the Peruvian Eocene gastropods were described in these papers, including the *Aulacodiscus lissoni,* and *Pseudoglauconia lissoni,* these two species representing new generic types.

The appearance of Bosworth's[7] Geology of North West Peru and its included Paleontological studies by Woods, Vaughan and Cushman marked a great advance in our knowledge of the Tertiary rocks of the region. It was preceded by several years of field studies by Bosworth and his assistants and proved the existence of a very thick and generally fossiliferous Tertiary section.

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[3] 1870—Nelson, E. T. On the molluscan fauna of the late Tertiary of Peru. Trans. Conn. Acad. Sci., Vol. 2, p. 186.

[4] 1899.—Grzybowski, J. Die Tertiarablagerungen des nordlischen Peru und ihre molluskenfauna. Neus Jahrbuch, Beilageband, Vol. 12.

[5] 1909.—Adams, G. I. An outline review of the Geology of Peru. Smithsonian Report for 1908.

[6] Douvillé, H. Compte Rendu Acad. Sci. vol. 171, p. 1345.
1920.—Douvillé, H. Compte Rendu somm. Soc. géol. France, No. 14, p. 193.
1921.—Douvillé, H. Journ. Conchyl. vol. 66, p. 1.

[7] 1922.—Bosworth, T. O. Geology of the Tertiary and Quarternary period of North-west Peru, with an account of the Paleontology by H. Woods. T. W. Vaughan, J. A. Cushman and others.

Spiekes's[8] monograph of the Zorritos Miocene fauna appeared about the same time as Bosworth's work on the older Tertiaries. It gives a rather full account of the Paleontology and Stratigraphy of the Zorritos formation.

STRATIGRAPHY

The Tertiary rocks of Northwestern Peru have an aggregate thickness of fully 25,000 feet and of this total, the lower 15,000 feet belong to the Eocene. For a description of the general Tertiary section, or the Oligocene and Miocene strata, the reader is referred to Bosworth, Spieker or to a more recent paper by Iddings and Olsson[9]. In this latter article, mainly on basis of detailed field studies since 1921, the Tertiary rocks are grouped into 13 formations and their areal distribution is briefly outlined. In the present article, only the Eocene or the lower part of the Peruvian Tertiary column will be discussed.

In Bosworth's classification, the lower Tertiaries are divided into the Negritos and Lobitos formations. He further subdivided his Negritos formation into two series named from their most distinctive fossil genera, the Turritella and Clavilithes series. These formations are very comprehensive and include beds ranging from the Lower Eocene to the Upper Oligocene and moreover contain several unconformities of regional character. For this reason they have been further subdivided through more detailed work. Bosworth's Negritos formation has been restricted to include only the rocks actually exposed at Negritos, namely the Lower Eocene or his Turritella series. For the Clavilithes series, the formational names the Salina, Pale Greda and Parinas have been adopted.

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[8] 1922.—Spieker, E. M. The Paleontology of the Zorritos Formation of the North Peruvian Oil Fields, The Johns Hop· University Studies in Geology, No. 3.

[9] 1928.—Iddings and Olsson, The Geology of North West Peru, Bulls. Amer. Assoc. of Petroleum Geologists, Vol. 12, No. 1.

The Lobitos formation as this term was used by Bosworth is primarily a lithological division and intended to include the rocks lying above the Parinas sandstone and below the highly fossiliferous Zorritos Miocene. It included in its lower part, beds belonging to the Upper Middle Eocene, whose faunal relations are closely allied to the Parinas and lower formations. This set of rocks, largely shale in the Negritos area but changing to sandstones and even to conglomerates further north, has been named the Restin formation, its type exposures being selected from Restin near Cabo Blanco.

The close of the Mid-Eocene was marked by important crustal movements, resulting in elevation and erosion of the earlier formed Eocene rocks. This was followed by renewed deposition in a more extensive scale than previously and the new transgression carried marine waters far beyond its former limits. An erosional unconformity of the first magnitude therefore marks the base of the Upper Eocene and these rocks are found on any of the older beds including the Cretaceous, or the slates and granites of the mountains.

The Upper Eocene rocks also included in the Lower Lobitos by Bosworth, have been named the Saman formation from their typical and highly fossilferous exposures at Casa Saman in the Chira valley and about 10 miles Northwest of Sullmana. The Upper Eocene seas brought the introduction of a new fauna, including the first appearance of the Nummulitic and Orbitoidal foraminifera in the Peruvian section, and this fauna continued in a modified form through most of the Oligocene. On the other hand, the relations of the Saman fauna with the older Eocene is comparatively less pronounced.

The divisions of the Peruvian Eocene as used in this article, are as follow:

	American Time Sub-divisions	Formations		Bosworth's divisions	
EOCENE	Upper	Saman		Lobitos formation	
	Middle	Restin Parinas	Parinas Group	Negritos formation	Clavilithes series
		Pale Greda Salina	Salina Group		
	Lower	Negritos		Turritella series	

THE LOWER EOCENE

THE NEGRITOS FORMATION

The Negritos formation has an exposed thickness of about 1,500 feet, but an additional 4,000 feet has been penetrated in well borings. The Upper 900 feet are dominantly sandy, with interbedded impure sandstones, pebble beds, shales and impure glauconites, while the underlying rocks are mainly shales.

The sandy member at the top of the formation, is generally highly fossiliferous, and it is from these rocks that the rich Negritos fauna has been principally obtained. This fauna is very distinctive. It is specially characterized by a group of large *Mesalia*-like *Turritella,* centering around the *T. negritosensis* Woods and suggested to Bosworth the name Turritella series which he adopted for this group of rocks. There are several species which do not occur in the overlying beds namely the *Aulacodiscus lissoni* H. Douvillé; *Peruluta peruviana* H. Douvillé typical form; *P. crassiscula* H. Douvillé; *Pseudolvia mutabilis* Woods typical form; *Melanatria dimorphica* Woods. *propinqua* Woods; *Bezanconia pupoidea* Woods; *Cerithium chatwini* Woods; *Ostrea buski* Woods; *negritensis Leda ingens* Woods and *Venericardia planicosta* var. *negritensis* n. var.

THE MIDDLE EOCENE

THE SALINA FORMATION

The Salina formation which forms the lower part of Bosworth's Clavilithes series has a thickness of about 800 feet. The rocks are dominantly sandy and resemble closely the upper member of the Negritos formation and are best distinguished paleontologically. Fanually the change from the Negritos formation is abrupt and there are no transitional beds between the two formations. The base of the Salina rocks is usually a conglomerate or a series of conglomeritic lenses varying considerably in thickness along the strike. It is believed that this zone marks an unconformity or disconformity and the time interval represented of sufficient duration to have allowed of considerable change in the fauna of the two groups of rocks. This Middle Eocene fauna continued in but a modified form through the rocks which Bosworth called the Clavilithes series. Aside from the Fusoid genus *Clavilithes* which seems to be absent from the older beds we find a new series of *Turritella* grouped about *T. bosworthi,* the peculiar Melanoid *T. anceps* and *annectans* Woods, *Pseudoliva mutabilis* var. *woodsi* n. var. *P. parinasensis* Wood *Melanatria acanthica* and *venusta* Woods, and *Venericardia planicosta* var: *parinensis* n. var.

Comparatively few species seem to be strictly limited to the Salina formation. *Turritella anceps* and *bosworthi* of Woods, *Diplodonta ? dissona* n. sp., *Pseudoliva mutabilis* var, *woodsi* n. var. and a few others are most common in this formation. The *Aturia cf. ziczac* Sby., is found only on the conglomerate zone at the base of the formation.

THE PALE GREDA FORMATION

The Pale Gredas are mainly a lithilogical division and consis of 2,000 to 2,500 feet of yellow, brown or gray shales, lying above the Salina formation and below the Parinas sandstones. Locally thin seams of sandstones and pebble beds may be present and these horizons are mainly interesting since they are usually fossiliferous and have furnished the bulk of the known Pale Greda fauna.

The fauna of the Pale Gredas is rather meager and on a whole does not differ greatly from that of the Salina—Parinas formations. In addition to a few undescribed species of rare occurrence, the following are known only from this formation: *Cerithium boweni* n. sp. *iddingsi* n. sp. and *Eutrephoceras negritensie* n. sp.

THE PARINAS FORMATION

Punta Parinas and the adjacent Punta Balcones, are together the most westerly points of the South American continent. They are formed of rather coarse, gritty, white or yellowish sandstones and pebble conglomerates, collectively known in the Negritos region as the Parinas sandstones or the Parinas formation. They were deposited in very shallow or near-shore waters and often contain large trunks of silicified wood, usually closely riddled with the borings of *Teredo*. Fossil zones are generally confined to the lower and upper part of the formation.

The fauna of the Parinas sandstones is largely that of the general Clavilithes series. It also contains a few special species of its own and a still larger proportion of new forms which continue into the overlying Restin. Species most characteristic of the Parinas sandstones are *Carolia* (*Parinomya*) *parinensis* n. sp., *Grateloupia peruviana* n. sp., *Pitaria parinensis* n. sp., *Turritella keswickensis* n. sp., *Telescopium parinense* n. sp., New forms beginning in the Parinas sandstones and continuing into the Restin, or even higher rocks include most of the common species such as *Turritella annectans* Woods (also in Upper Pale Gredas), *Morgana magma* Woods, *Clavilithes pacificus* Woods, *Amotapus arbolensis* Woods, *Cardium restinense* n. sp., *Clementia parinensis* n. sp. and *Corbula parenasensis* Woods.

THE RESTIN FORMATION

In the Negritos region, the Parinas sandstones are generally overlain by gray or olive colored shales varying considerably in thickness according to locality. The shales may contain small foraminifera but other fossils are rare or limited to local zones near the base of the formation. North of Negritos, the Restin shales have become interbedded with sandstones and are thicker and more generally fossiliferous. Still further north they are the basal Tertiary rocks and along the west side of the mountains represent mainly coastal sandstones and conglomerates.

The Restin fauna is closely related to that of the Parinas but is still more highly diversified, due to the appearance of new forms which become more common and characteristic of the Upper Eocene and later faunas. The following species are known only form the Restin formation. *Carolia peruviana* n. sp., *Anomia septanaria* n. sp., *Corbula* (*Cuspicorbula*) *busera* n. sp.,*Clementia restinensis* n. sp., *Cerithium xenium,* n. sp., *Architectonia jabonillensis* n. sp., *Hercoglossa peruviana* Berry and *"Echinocyamus" intermedius* Hawkins.

THE UPPER EOCENE

Upper Eocene rocks are widely distributed in the Tertiary area of North West Peru and include the bulk of the beds belonging to the lower half of Bosworth's Lobitos formation. They vary considerably in lithology from coarse sandstones, conglomerates, coquina-like beach limestones to massive black shales. Collectively they are grouped together in the Saman formation, named from their most typical and highly fossiliferous exposures found in the Chira valley at Hacienda Cusa Saman near Sullana.

As previously noted, the Saman rocks are everywhere strongly unconformable on the older beds. In the Negritos region, they rest upon the Restin formation or the Upper Middle Eocene. To the south they overlap upon the Cretaceous or older mountain rocks and represent the basal portion of the Tertiaries in that region. This unconformity at the base of the Upper Eocene is the most important stratigraphic break in the whole Teritary section of northern Peru.

The transgression of the Upper Eocene sea was of wide extent and Saman rocks were therefore deposited over a considerably larger area than the earlier Eocene formations. It brought a new fauna from which many of the most characteristic of the older Eocene species had dissappeared such as *Pseudoglauconia lissoni* Douvillé and other large Cerithoid shells. The species which had persistent from the earlier beds in some cases disappeared after a short range in the lower Saman, instance *Peruluta peruviana* var. *samanica* n. var., or continued their development and evolution, sometimes becoming very large before finally disappearing at the close of the Saman. To this class belong such species as *Venericardia planicosta* var *samanica* and *Amotapus* (*Perna* of Woods) *arbolensis* Woods. With the exception of the above but very conspicuous elements, the Saman fauna is largely a new development which persisted through the Oligocene but disappeared before Miocene times. The Saman and related Oligocene faunas are therefore to a certain extent a unit fauna which flourished between Middle Eocene and Miocene times.

The Nummulitic and Orbitoidal foraminifera are entirely lacking from the Lower and Middle Eocene rocks in Peru but immediately assume an important role in the Saman and Lower Oligocene formations. *Orthophragmina peruviana* Cushman and more rarely a stellate species occur only at the base of the Saman rocks associated with a special fauna of mollusks, echinoids and the brachiopod *Liothyrina peruviana* n. sp. This zone marks a very constant horizon which has been traced from Negritos north to Caleto Mero or a distance of more than 60 miles. It is sometimes represented by sandstones and conglomerates which have been called the Saman conglomerate but in many cases the base of the Saman rocks are shales overlying the Restin shales.

The Saman molluscan fauna is very rich and varied. At the base of the Saman or horizon of the Saman conglomeratte there are several species limited to this horizon. They include such shells as the *Polinices woodsi* n. sp. *Epitonium pervianum* n. sp., *Clavilithes pozœnsis* n. sp., *woodringi* n. sp., and *lagunitensis n. sp.*, *Lyra sabulosa* n. sp., *Cassidea maccormaki* n. sp., *Ovula negritensis* n. sp., *Cypraea boffsi* n. sp., and *Liothyrina peruvianum* n. sp. In the higher beds and more particularly in the Saman sandstones of the Chira valley, near the top of the Upper Eocene the following species are quite common: *Venericardia planicosta* var. *samanica* n. var., *Amotapus arbolensis* n. sp., *Arca sullanensis* Woods, *Ostrea samanensis* n. sp., *Spisula callistoides* n. sp., *Cardium samanicum* n. sp., *Lucina paytensis* Woods, *Pseudoliva parinasensis* var. *samanica* n. var. *Dientomochilus gaudichaudi d'Orbigny*, *Cerithium laevisculum*

Gabb, *Telescopium peruvianum* Woods and *samanensie* n. sp., *Turritella boughtoni* n. sp., and *Dorsanum lagunitensis* Woods. Among the common fossils of the Saman rocks but ranging widely in the Oligocene we may mention the *Peruluta mancorensis* n .sp., *Xancus peruvianas* n. sp., *Architectonica sullana* n. sp., *Turritella chira* n. sp., *samanensis* n. sp., *Clementia peruviana* n. sp., and *Aturia alabamensis* var. *peruviana* n. var.

CORRELATION

The occurrence of species of *Orthophragmina* in the basal portion of the Saman formation definitely correlates these rocks with the Upper Eocene and equivalent to the St. Bartholomew limestones of the Lesser Antilles and the Ocala limestones of Florida. Contributing evidence in support of the correlation is furnished by the Saman mollusks and other fossils. In this connection the range of the group of *Venericardia planicosta* through the Peruvian Eocene is of considerable interest. It is a common fossil first appearing as variety *negritensis,* a strongly ribbed form in the lowest fossiliferous members of the Negritos formation. In the overlying Clavilithes series, the shells are more convex with the sculpture becoming smooth on the ventral portion of the shell. These shells belong to the variety *parinensis* and find their closest parallel in the smooth varieties of *V. planicosta* in the Middle Eocene or Clairbornian rocks of the southern United States. The group reached its fullest development in the Saman rocks as variety *samanica.* It is a large thick shell with wide, heavy hinge and a smooth sculpture except on the umbos and early part of the shell disk. It represented the last of the *planicosta* group and became extinct at the top of the Saman formation, thus marking the upper limit of the Eocene series.

Several common Saman mollusks belong to genera or sections most characteristic of the later Tertiary faunas. To this class belongs the *Arca sullanensis* Woods, a large *Argina*-like species; large *Trigoniocardia* exemplified by *Fragum samanicum* and one or more undescribed species, a group previously known only from the Oligocene or younger rocks and specially common in the Miocene and recent faunas; the *Clementia peruviana* n. sp., the forerunner of the Miocene *Clementia dariena* Conrad to which it is very closely related; *Xancus peruviana* n. sp., a genus hitherfore not known earlier than the Vickburg Oligocene and common in the Caribbean Miocene; and the *Polinices woodsi* n. sp., a species belonging to the typical section and very close to the *Polinices subangulata* Nelson of the Zorritos Miocene and the recent West Coast *Polinices alveatus* Troschel.

Two species of the Cephalopd genus *Aturia* occur in the Peruvian Eocene. The earlier species, found only at the base of the Salina formation, appears to be most closely related to the *Aturia zic-zac* Sowerby from the Londinien or Upper Eocene of England. A second species of *Aturia* is found in the Saman Eocene and continues through into the Upper Oligocene. This species is often quite common and scarcely distinguishable from the *Aturia alabamensis* Morton from the Claiborne and Jackson beds of the southern United States.

Attention has already been called to the occurrence of the brachiopod *Liothyrina peruviana* in the Saman conglomerate. Related species occur at the same horizon associated with species of *Orthophragmina* in Colombia, in the San Fernando beds of Trinidad and the St. Bartholmew limestones.

DESCRIPTION OF SPECIES

Family PINNIDÆ Meek

Genus ATRINA Gray

Atrina talarensis, n. sp. Plate 4, fig. 3

Shell small to medium size, thin, moderately convex; the greatest convexity is situated in the anterior region, where a cross-section would show nearly a perfect circle; hinge-line straight while the lower or ventral margin appears to be slightly incurved; shell substance very thin, ornamented with longitudinal ribs or elevated lines which show on the inner surface as grooves and become impressed on the internal casts; the longitudinal ribs are low but nearly equal and regular, and number about 13 or 14 on the type specimen, and about midway between the anterior and posterior extremities, they are spaced about 1 1/2 mm. apart; the longitudinal ribs were probably somewhat spiny or nodose, especially near the posterior submargins; a band along the ventral submargins averaging about 5 mm. in width is smooth.

Length 53mm; height 40mm; diameter 24mm; fragmentary specimen

Remarks.— Although this species is fairly abundant at its type locality, specimens are always fragmentary, represented mainly by internal casts. It appears to be a small or medium-sized species reaching a maximum length of from 70 to 80 mm.

Locality and Geologic Occurrence.— Saman formation, Talara.

Superfamily OSTRACEA Goldfuss

Family OSTREIDÆ Lamarck

Genus OSTREA Linné

Ostrea negritensis, n. sp. Plate 2, figs. 4, 5, 6

Shell small or medium-sized, rarely exceeding 60 mm. in length; the lower left valve convex and rather heavy, typically ostroid or in some cases strongly exogyroid in form, this latter condition being due to an exaggerated or greater coiling of the beaks; surface of the left valve generally smoothish, but with evident but nearly obsolete radial folds or ribs; the interior of the left valve shows a curved or slightly coiled, ligamental area, directed posteriorly and passing into or under the beaks, most pronounced in the exogyroid shells; anterior and posterior internal margins of the shell strongly and regularly punctate or crenulated.

Length or width 35mm;	height 59mm;	diameter (left valve) 30mm
32mm;	height 52mm;	28mm

This is an interesting species found only in the Lower *Turritella* beds of Negritos. All the specimens in our collection represent the left valves, so that the characters of the upper or right valve are not known. From the *O. buski* Woods, with which the species is associated, it is recognised by its curved or posteriorly directed ligamental area, and by its nearly smooth shell.

Ostrea negritensis shows much variation in the extent of coiling of its beaks, and in some cases this condition is carried to such an extreme that were the shells found in Cretaceous sediments, they would be classed as a species of *Exogyra* without hesitation. However this character is very variable and all gradations to typical Ostroid shells may be found. It is significant however that *O. negritensis* is found only in the lowest exposed fossiliferous rocks of the Peruvian Tertiary and belong to the Lower Eocene. The European literature contains records of *Exogyra* as high as the Miocene.

Formation.— Negritos formation, Negritos.

Ostrea samanensis, n. sp. **Plate 1, figs. 1, 2, 3, 4, 5**

Shell medium to large; young shells are usually subcircular in form, but become oblong or elongate with age; valves unequal, the lower or left valve usually convex and sculptured with strong, subregular, sulcated, radial ribs; the upper or right valve of less convexity or sometimes flat, smooth or sculptured only by the concentric growth lines; the beak of the lower valve when perfect is usually strongly curved or Exogyroid, with a small or large area of attachment; in old shells, the radial ribs of the left valve usually become obsolete and the lower half of the shell tends to be smooth, except for the lamellations caused by the growth lines; texture of the shell of medium thickness except in very large shells; the hinge of the left valve shows a curved ligamental area, while in the right valve, the ligamental area is more nearly straight.

Height 52mm; width 44mm; diameter 25 mm; (Holotype)
57mm; width 42mm; diameter 19mm lower valve;
82mm broken; width 57mm; diameter 30mm lower;
88mm; width 36mm; diameter 23mm upper

This species bears some resemblance to the *Ostrea sellæformis* variety *lisbonensis* Harris from the Lower Claiborne or St. Maurice beds of the Louisiana, but differs typically by its more strongly coiled beaks and by its greater convexity of form. The lower or attached valve is strongly ribbed or costate, and the upper valve is flat and simply sculptured with concentric growth-lines. It is a common species throughout the Peruvian Upper Eocene.

Locality and Geologic Occurrence.— Saman formation, type specimens from Casa Saman, but common throughout the Saman Eocene.

Superfamily ANOMIACEA Hermannsen

Family ANOMIIDÆ Gray

Genus ANOMIA Muller

Anomia septenaria, n. sp Plate 2, figs. 2, 3

Shell of medium size, averaging about 35 mm. in height and length but sometimes growing to a larger size; the upper or left valve is convex, subcircular in form and moderately heavy in texture; surface typically sculptured with 7 rather heavy, angular ribs which are regularly spaced and give the shell a *Pecten*-like appearance; these ribs are continued through the shell and show on the internal casts of the fossils; the ventral margins of the shell is strongly scalloped by the ribs, and the two valves fitting closely together; the interspaces between the ribs is wide and generally smooth, or faintly striated by the concentric growth lines; the right valve as preserved in our specimens is flat or slightly concave and somewhat irregular in form and generally smooth; the byssal foramen of medium size and open; internal characters concealed.

Height 40mm; length 44mm;
36mm; length 37mm; diameter 19mm

Remarks.— This is a peculiar shell, quite unlike any species of *Anomia* which I have found described. It is quite common in the Upper Restin sandstones but good specimens are rare and usually only casts with patches of the original shell may be collected.

In two of our specimens, the right valve is preserved, the one showing a medium-sized byssal foramen, and proving the shell to belong to the *Anomiidæ,* otherwise it might easily have passed for a small oyster. The internal characters are completely concealed and the shells are therefore referred only provisionally to the genus *Anomia.*

Localities and Geologic Occurrence.— Restin formation, Que. Salado, Jabonillal, Lobitos.

Genus CAROLIA Cantraine

Subgenus CAROLIA s. s.

Carolia (Carolia) peruviana, n. sp. Plate 2, fig. 1

Shell moderately thin, subcircular in form, or with the height somewhat exceeding the length; left valve slightly to moderately convex, with broad inconspicuous umbo and beak; right valve flat or slightly concave; external surface of valves covered with a fine, sculpture of vermiculate, close-set radial striæ or threads, internal characters concealed.

Height 68mm; length 66mm; diameter of left valve 15mm
50mm; length 45mm; diameter 6mm;

In the true *Carolia,* of which the *C. placunoides* Cantriane from the Egyptian Eocene is the type species, the external surface is sculptured much as in *peruviana* with fine, vermiculate radial threads. In this feature, *peruviana* also resembles *C. jamaicensis* Dall [1] from the Cambridge beds of Jamaica and considered by Dall as a true *Carolia.* The internal characters by which *Carolia* is best distinguished, are entirely concealed in the specimens at present available for study.

This species largely replaces the *C. parinensis* in the Restin formation and from which it will be recognised by its submicroscopic sculpture referred to above.

Subgenus PARINOMYA n. subg.

Type.—Carolia parinensis, n. sp.

The following is a description of the subgenus *Parinomya:*

Shell in form and general features like *Carolia* s. s., but the exterior marked with a submicroscopic rasp-like or pectinate sculpture, the finer growth lines being drawn out at intervals into teeth-like extensions, radially arranged; resilium internal; interior of right valve with a large chondrophore which as in *Carolia* s. s., is seated on the anal or posterior side of the umbo and extends adorally above the byssal foramen, but remaining free or separate from the dorsal margin by an open slit or cleft; byssal foramen large, open, or closed only by a byssal plug.

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[1] Trans. Wagner Free Inst., vol. 3, pt. 4, p. 776, pl. 33, fig. 21.

Remarks.— Fischer[2] has fully described and figured the internal characters of the *C. placunoides* Cantraine, the type species of *Carolia* s. s., from the Egyptian Eocene. In the young stages,the byssal foramen of the right valve is fully open and *Anomia*-like. With growth, the foramen gradually atrophies and in mature shells, it is completely closed by shelly matter and often hardly discernable as a scar. The chondrophore carrying the resilium, rises from the posterior side of the umbo, extends across the upper edge of the shell, its outer or upper edge becoming fused to the cardinal margin of the shell. The various changes passed through by *Carolia,* in its development, are divided by Fischer roughly into 4 stages, comparable to the adult condition of allied Anomoid genera.

In *Parinomya,* the developmental changes are less complete, the foramen although becoming reduced in size, is persistant and well-marked even in the senile or gerontic individuals. It is generally filled with a close-fitting corneous plug. In addition, the chondrophore does not seem to fuse with the anterior-dorsal margin, but remaining separated by a well-developed slit. The external characters will also help in discriminating this from true *Carolia.*

Carolia (Parinomya) parinensis, n. sp. Plate 3, fig. 1-4

Shell of moderate size, subcircular and somewhat irregular in growth; shell substance nacreous, fairly heavy and composed of fine, silvery *Anomia*-like lamellæ; right valve flat or slightly concave, the left valve deeper and evenly convex; in the right valve, the resilium is seated on a large, heavy chondrophore rising from the posterior side of the umbo, and extending adorally above the byssal foramen, but remaining free or separated from the cardinal margin by a deep slit or cleft; byssal foramen of the right valve, circular and generally rather large, remaining open or simply closed by a byssal plug, and situated at a varying distance from the dorsal margin; muscle scar in the right valve, nearly circular, and in old shells generally sunken or surrounded by a thickened margin; the exterior of the shell is usually weathered and the surface is smooth, or strongly lamellos near the ventral margins; in well-preserved specimens, the finer sculpture is rasp-like or pectinate, the finer growth-lines being drawn out at fairly regular intervals into teeth-like extensions; as these teeth-like extensions follow in a fairly regular order, they produce a fine radial sculpture.

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[2] Journ. de Conchyl., 28, p. 345, pl. 12; Man. de Conchyl. p. 933, fig. 700; see also Dall, Trans. Wagner Free Inst, vol. 3, pt. 4, p. 775.

Length 78mm; height 62mm; diameter 11m,(right valve,Holotype)
Length 64mm; height 62mm; diameter 16mm;
64mm; height 62mm; diameter 19.5mm

C. parinensis is a common and characteristic fossil of the Parinas sandstone but also occurring less commonly in the overlying Restin. From *C. peruviana,* it will be recognised by its submicroscopic external markings.

Localities and Geologic Occurrence.— Parinas formation of Parinas and Balcones Points, Keswick Hills, etc. Cabo Blanco sandstones of Cabo Blanco and Cabo Verde.

Restin formation, Jabonillal.

Superfamily MYTILACEA Ferussac

Family MYTILIDÆ Fleming

Genus MYTILUS Linné

Mytilus euglyphus Woods, var. negritensis, n. var. Plate 4, fig.4

Mytilus euglyphus? Woods 1922, Bosworth Geology of North-West Peru, p. 63, pl. 1, fig. 8.

Differs mainly from the *euglyphus* Woods, by its coarser sculpture and in form, the longer axis or the height of the shell being nearly at right angles to its length; the shell is strongly ridged and this line or crest divides the sculpture into two unequal areas; the posterior area is uniformly coarse, sub-regular and unbeaded, but along the margins the ribs become divided into smaller rays through bifurcations or new, small and shorter ribs are introduced; the antero-ventral margin is concave, sculptured with finer beaded ribs; as usual there is a tendency to the formation of a narrow patch without sculpture and lying a short distance below and behind the beaks, but with the resumption of sculpture again just below the beaks; internal characters concealed.

Height 35mm; length 29mm; diameter 8mm right valve

This shell differs from *M. euglyphus* Woods, described from *Clavilithes* beds (Salina-Parinas) in its coarser sculpture and in form. The *Mytilus euglyphus?* Woods figured from the *Turritella* beds may be the same. *Negritensis* should probably have the rank of a full species.

M. euglyphus is compared by Woods to *M.Rigaulti* Deshayes[3] of the Parisian Eocene and referred by Cossmann to the Section *Arcomytilus.* He also compares *euglyphus* with *Modiola Foncki* Philippi [4] from the Tertiaries of Lebu Chile. *M. Foncki* Philippi from Chile is strongly accurate but less so than *negritensis. M. euglyphus* var *negritensis* occurs in the Negritos formation, while typical *euglyphus* ranges through the Salina formation into the Parinas and Restin formations.

Family AMOTAPIDÆ n. fam.

Genus AMOTAPUS n. gen.

Type.—Perna arbolensis Woods Plate 4, figs 1, 2, 5

The following is a description of the genus *Amotapus.*

Shell very thin, with deep, regular, *Inoceramus*-like concentric undulations, continued through to the interior of the shell; general form of the shell Pernoid, with the height much exceeding the width; hinge straight, plain, smooth, or simply longitudinally grooved; left valve with a large *Mya*-like chondrophore carrying the internal resilium, and fitting into or under a corresponding socket or depression in the right valve lying immediately below the beak.

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[3] Deshayes. 1862, Descript. Anim. sans Vert., 2, p. 29, vol. 1, pl. 74, figs 23, 24.

Cossmann and Pissarro, 1904-1906, Icon. des coquilles fossiles de l'Eocene des environs de Paris, Tome 1, pl. 37, figs. 112-6.

[4] Philippi 1887, Die Tert. und Quart. Verstein Chiles, p. 204, pl. 43, fig. 1.

Remarks.— The type species of this new genus was described by Woods, as *Perna arbolensis* from a specimen collected by Bosworth from the Parinas sandstones. It first appears in the Parinas formation where the species is always small and the largest specimens which have come to my attention measure about 45 mm. in height. It continues into the upper Eocene, reaching progressively a larger size in the higher rocks, finally disappearing along with the *Venericardia planicosta* var *samanica* at the top of the Saman formation. In the Saman conglomerate, the shells are still small like those from the Parinas formation. In the Saman shales or the Lower Upper Eocene, the largest specimens come from Caleta Sal, the average size being about 55 mm. in height, but in the Saman sandstones of the Chira valley, at the top of the Upper Eocene, the shells are very large, often exceeding 100 mm. in height.

The general shape of the shell is very similar to *Pedalion* (*Perna* or *Melina*), and upon the external form alone, this would be the relations at once suggested. The shell substance is thin and sculptured with regular concentric waves or undulations, and this sculpture as in *Inoceramus,* is continued through to the interior of the shell, becoming impressed with nearly equal intensity upon the internal casts. The shells of the typical Pernas are usually smooth, sometimes very heavy, are ribbed in the section or subgenus *Mulletia* Fischer , but forms concentrically sculptured are rare or unknown. It is however in the hinge characters that the form departs widely from the *Pernidæ* and apparently from other Monomyarian families.

In most cases the fossils are found as internal sandstone casts with only patches of the very thin shell still remaining. In these casts, the hinge is usually buried under the closely adjacent beaks or if exposed badly worn or weathered. By breaking away the right beak of small well-preserved specimens from the Parinas sandstones, the hinge is sometimes exposed for study. These specimens show a smooth, hinge-line devoid of the serial ligamental pits of the *Pernidæ,* and the left valve provided with a fairly large, flat or Mya-like chondrophore fitting into a corresponding depression under the beak of the right valve. In the larger specimens from Caleta Sal, the hinge is sometimes partly preserved, with remains of the large, but much weathered chondrophore. These specimens from Caleta Sal are of value in showing that the possession of a chondrophore is a constant and persistant character.

Order ANOMALODESMACEA Dall

Superfamily ANATINACEA Dall

Family THRACIIDÆ Dall

Genus THRACIA Leach

Thracia staufti, n. sp. Plate 9, fig. 1

Shells of medium size, thin elliptical to subcircular in outlines; in the typical form, the shell is ellipitical with the posterior side wide and about twice as long as the anterior; anterior end contracted, depressed and relatively short, and with the extremity subtruncate; beaks small pointed and directed slightly anteriorly; convexity of the valves is slight, that of the right being generally greater, while the left may be flat or depressed; ventral margin well-rounded; the posterior-dorsal margin straight, and more or less parallel to the anterior side of the ventral margin; substance of the shell is very thin, irregularly, concentrically undulate or plicate, and in addition the surface is covered with a fine sculpture of small granules, arranged in close-set radiating lines; hinge not preserved.

Length 42mm; height 28mm.

Remarks.— This species occurs quite abundantly in the Upper Restin sandstones of Quebrada Conventos between LaBreita and Fernandez of the Upper Mancora valley. The typical form is generally sub-elliptical or subovate, but possibly due to crushing certain other shells have a subcircular outline.

Without the contributing evidence of hinge characters, the present species has been referred to the genus *Thracia,* mainly on its general form, and fine submicroscopic granulation of its valves. The shells also appears to have been originally nonnacreous which would exclude it from the *Periplomatidæ.*

A similar species has been described by Cossmann and Peyrot as *Thracia* (*Cyathodonta*) *Dollfussi,* from the Miocene of the Aquitanien Basin in France. The European shell is more equilateral, with stronger concentric ripples, which are however strictly concentric and not oblique as in the typical *Cyathodonta.* The *Periploma collardi* Harris from the Lower Claiborne is similar to the more circular shells, but possesses a pearly shell and is a true *Periploma.*

Locality and Geologic Occurrence.— Restin formation, Que. Conventos.

Order TELEODESMACEA Dall

Superfamily CARDITACEA Menke

Family CARDITIDÆ Gill

Genus VENERICARDIA Lamarck

Venericardia (Venericardia) planicosta Lamarack (group)

Venericardia planicosta Lamarck (group) Woods 1922, Bosworth Geology of North West Peru, p. 66-70, Pl. 3, figs. 2, 3, pl. 4, figs. 1-3.

The well-known *Venericardia planicosta* was described by Lamarck in 1801, as a Lutetian or Middle Eocene fossil from the Parisien Basin. It is however in the west Atlantic or eastern Pacific region, where the *planicosta* group reached its acme of development and as fossil occur throughout the marine Eocene along both the east and west coast of North America. They constitute our most characteristic and reliable guide fossils for the marine American Eocene.

In Peru, the members of the *planicosta* group are abundant fossils through the entire Eocene section. Beginning in the lowest exposed, fossiliferous members of the Negritos formation (*Turritella* beds) of Lower Eocene age, they continue uninterruptedly through to the top of the Saman sandstones of the Chira valley and Paita. Although a part of the Upper Eocene fauna may continue into the overlying rocks referred to the Oligocene, the group of *Venericardia planicosta* does not pass above the Saman formation.

In their range from the Lower to the Upper Eocene, several mutations or varieties are developed, and Woods in his work on the Bosworth collection, has figured and described, the principal forms occurring in the lower and middle portion of the section. In general these varieties have a limited stratigraphic range, and as their characters are quite constant, they are entitled to at least subspecific recognition. In general the Peruvian shells differ from the typical European type and its subspecies from other regions, in having a less number of ribs, generally between 22 to 24. The

Peruvian subspecies and their range is as follows:

1. var. *negritensis,* Negritos formation (*Turritella* Series) Lower Eocene
2. var. *parinensis*, Salina to Parinas formation (*Clavilithes* Series) Middle Eocene
3. var. *restinensis,* Restin formation. Upper Middle Eocene
4. var. *samanensis,* Restin and Saman formation. Upper Eocene

Venericardia planicosta var negritensis, n. var. Plate 5, figs. 1, 2

Venericardia planicosta Lamarck (group) Form A. Woods, 1922, p. 66, pl. 4, fig. 1

Venericadia, sp. Woods, 1922, p. 69, pl. 4, fig. 4.

This variety is the common and characteristic type in the Negritos formation. The usual form is obliquely subtrigonal with low, flattened umboes and with erect or but slightly curved or inclined beaks. The shells are but slightly convex, sometimes appearing flattened or depressed especially near the ventral or basel margins. The sculpture is strong, with relatively few, heavy persistant ribs, widening out very noticeably towards the ventral margins. On the umbos, the ribs are high and narrower than the deep, groove-like interspaces, but they broaden rapidly and near the ventral margin, flatten and become 5 or 6 times the width of the shallow but distinct interspaces. From the anterior extremity to the umbonal slope, the ribs number from 17 to 19.

The umbonal slope or ridge is usually well-defined, and the sculpture of the dorsal-posterior submargins is quite different from the rest of the shell disk. Except in the very earliest stages, the ribbing of the dorsal margins is weak, the ribs quickly fading out distally, and the surface becoming smooth or sculptured simply by crowded growth lines. The low ribs of the posterior-dorsal submargin number 4 or 5, so that the total number of ribs over the whole surface is 22 to 24.

Localities and Geologic Occurrence.— Negritos formation, Negritos LaBrea.

Venericardia planicosta var parinensis, n. var. Plate 5, fig. 3

Venericardia planicosta Lamarck (group) Form B and C, Wood, 1922, p. 67, pl. 3, figs. 2, 3.

This variety begins in the Salina formation, continues up through the Pale Gredas into the Parinas, or characteristic of the group of rocks, placed by Bosworth in his *Clavilithes* series. Usually the earlier forms are but moderately convex, with stronger ribbing extending over the umbos onto the center of the shell disk but fading out rapidly nearer the ventral margins (see Woods's fig. 2). In the Parinas sandstone, the shells are generally larger, heavy, with full convex umbos, curved beaks and a heavy, high hinge (see Woods's figure 3). The sculpture is weak and confined to the umbos and earlier portion of the shell disk, leaving the major part of the surface smooth, except for growth lines. The umbonal slope is rounded as in the Parisien and Claibornian shells, and the dorsal submargins are but feebly differentiated. The ribs number as in *negritensis,* about 17 to the umbonal slope, and 22 to 23 over the whole surface.

In this type we find a close approach to the smoother forms of *V. planicosta* from the Upper Wilcox and St. Maurice horizons of Louisiana and Alabama, designated as variety (gamma) by Harris [5], and to *V. ionensis* Waring [6] (*V. merriami* Dickerson), from Oregon and California. In each case, these smooth *Venericardia* are found in rocks of Middle Eocene age.

Venericardia planicosta var. restinensis, n. var. Plate 6, fig. 2,

During the Restin or the Upper Middle Eocene, the conditions for the growth and evolution of this series of *Venericardia,* does not appear to have been specially favorable, and the shells are generally small, rarely exceeding 50 mm. in length. They vary from well-rounded to subquadrate in form, strongly convex with heavy ribs extending over two thirds of the surface, becoming obsolete or fading over the central portion. The ribs number about 17 to the umbonal angle, with 5 or 6 additional ones on the dorsal-posterior submargins. The umbos are full, convex, with small, curved beaks and small deeply sunk lunule. The posterior submargin is somewhat ridged in the middle, bordered with a depressed or concave zone on the outer side.

An interesting *Venericardia,* probably belonging to the *planicardia,* stock was described by Grzybowski [9] as *V. clavidens,* and he lists the fossils both from Zorritos and Rica Playa. From Grzybowski's Zorritos records, one would presume the fossil to be of Miocene age, but the species is not mentioned by Spieker in his studies on the Zorritos fauna, or have any specimens been found in the course of our own extensive collecting in the Miocene rocks of northern Peru. It is therefore most probable that Grzybowski's specimens were collected only at Rica Playa, where Miocene beds are found over-lapping on the Upper Restin and Lower Saman Eocene. *V. clavidens* resembles variety *restinensis* by its small size, and in sculpture, but differs by its strongly pointed posterior extremity and by its hinge. The hinge of *clavidens,* shows in the right valve, a small tooth rising from the posterior end of the nymphs. In this feature *clavidens,* shows an approach to *samanensis,* occupying an intermediate position between that variety and *restinensis,* which its stratigraphic position at Rica Playa, would also indicate.

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[5] Harris, 1919, Bulls. Amer. Pal., No. 31, vol. 6, p. 78, pl. 28, fig. 3, pl. 29, fig. 1.

[6] Waring 1914, Journ. Geol., vol. 22, p. 789; 1917, Proc. Calif. Acad. Sci., ser. 4, vol. 7, No. 4, pl. 11, figs. 1, 2.

Hanna, 1925, Notes on the Genus *Venericardia* from the Eocene of the West Coast of America, Univ. of Calif., Bull. Geol. Dept., Vol. 15, No. 8, p. 284, pl. 36, figs. 1, 2, 4, 4, 6, 7 and 9., pl. 42, figs. 1, 2.

[9] Neues Jahrb. fur Min. etc., Beil. Band vol. 12, p. 636, pl. 19, fig. 1.

Localities and Geologic Occurrence.— Restin formation, Negritos, Pozo valley near Lagunitas and Lower Verdun, Jabonillal, Restin.

Venericardia planicosta var. samanensis, n. var. **Plate 5, figs. 4, 5**
Plate 6, fig. 6

In this variety, we have the final and culminating product of evolution of the Peurvian group of *V. planicosta.* It occurs rarely in the Restin rocks but becomes at once common and typical in the succeeding Saman. The shells are often very large, massive, typically hatchet-shaped with height exceeding the width. They are moderately or strongly convex, with wide, full umbos and strongly coiled beaks (but less than in *parinensis*). The ribbing is strong in young shells and on the umbos of larger specimens, and persists over a larger area than usual in var. *parinensis.* Usually in large shells, the ribbing extends over the upper half, leaving the lower part smooth or simply marked by faint radiating lines representing the faded out ribs and by the growth lines. The usual number of ribs is about 21, those on the posterior-dorsal submargins being low and subobsolete. On the Restin specimens, the ribbing is heavier and persist over a relatively larger area, and the interspaces are deeper and more groove-like (see fig. 4), while the ribbing on the Saman shells is more rounded, and the interspaces are much narrower.

The hinge of the full-grown shell is very wide and massive. Its most striking feature is the development of wide, high and vertically flattened nymphs, which project upward and around which the ligament is attached. This adaptation is a natural one, as the area of ligamental attachment must be increased to care for the increased size and weight of the mature shell. In rare cases, the ligament itself has been preserved, and shows as a large, massive plug, projecting above and in a posterior direction along the dorsal area of two valves. A similar development of the nymphs but to a much less degree, is seen amongst the typical *planicosta* of the Parisian basin[10]. *V. planicosta* from the southern United States, do not show this condition, and the nymphs are relatively small and narrow.

Length 94mm; height 100mm; diameter 65mm; (type) Saman sandstone
75mm; height 80mm; diameter 63mm; Restin specimen

Localities and Geologic Occurrence.— Restin formation; Que. Salado. Saman formation; Horizon of the Saman conglomerate, Negritos, near Lagunitas, etc. Very abundant and large in the Saman sandstone of the Chira Valley, Paita, Bayovar, etc.

Venericardia peruviana, n. sp. **Plate 6, fig. 1**

Shell rather large, inequilateral, broadly ovate or subelliptical in form and with the low beak situated very close to the anterior extremity; posterior side widely rounded, the dorsal somewhat arched, the ventral gently rounded or nearly straight, anterior margin shorter; the shell is moderately convex, greatest just about the center of the disk, the umbos are low and not conspicuous with small, prosogyrate and closely adjacent beaks; the lunule is very small; there is a faint depression or sinu, extending across the dorsal side of the umbos to the posterior margin and serves to separate the faintly sculptured posterior-dorsal submargins from the heavier sculptured surface below; sculpture consists of moderately heavy, V shaped ribs which cover most of the shell surface; on the umbos, the ribs are heavy and strongly V shaped or ridged but become rounded and wider towards the posterior-ventral extremity; the ribs number about 19 from the anterior margin to the faint umbonal sinus, with 5, very faint, additional ribs on the posterior-dorsal slope; interior concealed.

Length 80mm; height 66mm; diameter 41.5mm;

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[10] Catalogue Illustré de la Collection Lamarck. Museum D'Histroire Naturelle de Geneve, Premiere Partie, pl. 23, fig. 126b, pl. 24, fig. 126d Cossmann, 1901, Bull. Geol. Soc. France, vol. 1, p. 652-656, figs. 1 and 2.

Remarks.— There appear to be no closely related species to which this shell need be compared. It differs from the *planicosta* group by its form and V-shaped ribs. The umbonal surface is somewhat weathered in our specimens, but the ribs appear to have been slightly beaded and keeled.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Venericardia pacifica, n. sp. Plate 6, figs. 3, 5

Shell small or moderate size, rounded or subcircular in outlines and rather strongly convex; the beaks are situated about the anterior one fourth; the dorsal margin is straight while the anterior and posterior extremities are well rounded and together with the base or ventral margin form part of a curve which is nearly circular; umbos full and quite prominent with small, slightly prosogyrate, adjacent beaks; lunule very small; sculptured with about 28 ribs (about 19 to the umbonal slope); on the umbos, the ribs are narrow, elevated and beaded, and with deep U-shaped interspaces fully three times the width of the ribs themselves; the ribs change abruptly at a resting mark, and below this point, become wide, flattened or rounded on top and separated simply by incised lines.

Length 41mm; height 42mm; diameter 31mm;

Remarks.— This species occurs with the preceding and from which it is recognised by its circular form and character of its ribs.

Locality and Geologic Occurrence.— Salina formation Negritos.

Family DIPLODONTIDÆ Dall

Genus DIPLODONTA Brown

Diplodonta? dissona, n. sp. Plate 9, figs. 8, 9

Shell lenticular, nearly equilateral, inequivalve; the right valve is moderately convex with wide but not prominent umbos and small inconspicuous beak; the left valve is flat or somewhat depressed in the ventral half and generally slightly flexed towards the left in the anterior portion; the beaks in each valve are small, close, and inconspicuous; the dorsal or hinge margin is rounded, that of the right valve slightly overlapping the left; basal or ventral margin is straight or very slightly rounded; the posterior side is subtruncate, the anterior subtruncate to rounded and the resulting outlines of the shell is subquadrate; there is no lunule or escutcheon but a faint sinus may be present along the left, posterior dorsal margin; surface sculpture consists of fine, regular, concentric threads on both valves; interior of the shell, judging by molds, show a simple and continuous pallial line; hinge unknown.

Length 22mm; height 19mm; diameter 7.75mm;

Remarks.— This species is remarkable in having dissimilar valves, the left valve being smaller, flat or depressed and slightly overlapped by the right valve along the dorsal or hinge margin. In other respects, the shell by its shape and essentially non-Lucinoid anterior muscle scar, has the appearance of a medium-sized *Diplodonta* and for these reasons, I am referring this fossil to the genus Diplodonta, rather than amongst the *Lucinidæ.*

The pallial line as shown on certain internal molds is simple and connected to the base of a circular or ovate, anterior muscle scar and not above as typical of most Lucinas. The hinge is not preserved in our specimens but judging from certain internal molds, there appear to have been no lateral teeth.

This species is quite common in the Salina formation, particular near the base.

Locality and Geologic Occurrence.— Salina Formation, Negritos.

Pale Greda formation, Negritos.

Subgenus RINGICARDIUM Fischer

Cardium (Ringicardium) restinense, n. sp. Plate 11, fig. 1

Shell of medium size, inflated, somewhat auriculate and nearly equilateral; umbos high and prominent, and situated nearly midway between the anterior and posterior extremities; ventral margin evenly rounded with the posterior margin nearly straight or subtruncate; the anterior margin is straight or slightly rounded; the posterior-dorsal slope is depressed or concave and differs from the rest of the shell by its finer ribs; the sculpture consists of fairly wide, flat ribs, separated by narrower, groove-like anterior to the umbonal angle and about 10 on the posterior-dorsal submargins; over most of the surface of the shell, the ribs are flat and smooth; on the umbonal angle and along the anterior part of the shell, the ribs carried small hollow spines, represented on the fossil shells mainly by their broken bases; the edges of the ribs on the posterior-dorsal submargins are beaded and the interspaces ocassionally wrinkled or waved.

Length 46mm; height 47mm; diameter 39mm;

Remarks.— This species is closely related to *C. harrisi* Vaughan form the Claiborne of the United States, agreeing most closely with the variety *gainesense* Harris. Direct comparison of specimens show the Claiborne species as being much larger and with fuller umbos.

The subgeneric or sectional relations of this species, as well as *C. harrisi* is doubtful. Dall in a brief review of a number of fossil Cardiums, suggested that *C. harrisi,* might be supposed to belong to *Tropidocardium* Rœmer, except that the shell does not gap. The type species of *Tropidocardium,* namely *C. costatum* Linne is a recent East Pacific shell, with high, ridge-like ribs, a channel interior and posterior gap, features quite different from those shown by either *C. harrisi* or *restinensis.* According to Cossmann, *Tropidocardium* is not known in a fossil state.

The subgenus *Ringicardium* Fischer, type *C. ringens* Chemnitz a recent species, but represented by a number of fossil European shells, has generally flattened ribs, sometimes bearing large spines, an inflated and often subauriculate shell. The posterior extremity is gaping and but partially closed by spine or tooth-like projections of the ends of the posterior set of ribs. In *restinensis* and *harrisi* there is no posterior gap, the valves fitting closely all around. On the other hand, the *C. procerum* Sby, a fairly common shell along the Pacific coast of Peru, is generally referred to *Ringicardium.* In this species, the gap is very small and the tooth-like extension of the ribs is very slight.

Localities and Geologic Occurrence.— Restin formation, Restin, Jabonillal, Pozo valley etc.

Subgenus FRAGUM Bolten

Section TRIGONIOCARDIA Dall

Cardium (Trigoniocardia) samanicum Dall Plate 11, fig. 2

Shell solid, high, convex and truncate behind; umbos high and prominent and with the greatest convexity of the shell about the center of the shell disk; ventral and anterior margins evenly rounded; the posterior margin is straight and meeting to form nearly a right angle with the basal margin; the posterior-umbonal slope is angled, with a slight sinus or depressed band lying just in front; the posterior-dorsal submargins are depressed or concave but rising again to form a broad ridge along the valve margin; sculpture consists of heavy, ornamental ribs and interspaces, somewhat smaller on the posterior-dorsal submargins and close to the anterior extremeties; there are about 15 ribs anterior to the umbonal angle and about 6 on the posterior truncation; the larger ribs are rather low, wide and not sharply separated from the bordering interspaces; the summit of the ribs, usually carry a shallow, wide channel or groove, generally ornamented with an elevated thread or a series of coarse beads or ventrally directed small scales or spines; the interspaces usually carry a broad elevated thread and the edge of the ribs are scalloped or cross-striated by evenly spaced incised lines; the ribs or the posterior truncation similarly sculptured; interior concealed.

Length 28mm; height 31mm; diameter 25mm;

Remarks.— This is an elegant species, fairly common in the Saman sandstones of the Chira valley. It is probably a *Trigoniocardia* Dall, a sectional group composed mainly of small species, distinctly Tropical American in their distribution, and heretofore recorded as fossil only from Oligocene and younger rocks.

Locality and Geological Occurrence.— Saman formation, Casa Saman.

Superfamily VENERACEA Menke
Family VENERIDÆ Leach
Genus CLEMENTIA Gray
Subgenus CLEMENTIA s. s.

Clementia (Clementia) peruviana, n. sp. Plate 7, figs. 1, 2, 7

Shell of medium size, inequilateral with the beaks situated at or near the anterior four fifths, the posterior portion of the shell is therefore much longer and the height of the shell being greatest just above the middle; posterior extremity slightly rounded or more obviously truncate; ventral margin well rounded and passing into the relatively short anterior extremity; the convexity of the shell is only moderate and the umbos are therefore not strongly inflated; the posterior dorsal submargins are made slightly concave by a groove-like depression, disappearing anteriorly beneath the beaks; surface sculpture consisting of coarse, concentric, waves, heaviest on the umbonal and early portion of the shell, but gradually become irregular and less heavy towards the ventral margin, finally disappearing or becoming indistinguishable from the growth lines; a finer sculpture of growth lines covers the entire shell; the hinge of the right valve (Saman sandstone specimen) shows a small anterior cardinal tooth, a heavier middle cardinal tooth and a long bifid posterior cardinal; hinge of left valve unknown.

Length 45mm; height 32mm broken; Semidiameter 11mm
(Holotype) Saman Sandstones
40mm; height 38.5mm; Diameter 22mm; Caleto Mero.

Remarks.— *Clementia peruviana* is a common fossil in the Peruvian Tertiaries, beginning in the Restin formation or the upper part of the Middle Eocene, where it is however very rare, and extending through the Upper Eocene and Oligocene rocks. It became extinct sometime during the Upper Oligocene and in the succeeding Miocene, it is replaced by the larger and well-known *Clementia dariena* Conrad.

From *C. dariena,* the Peruvian *Clementia* is distinguished by its smaller size, generally less convex and more depressed shell and by its weaker sculpture. In *C. peruviana,* the concentric waves which are strongest and heaviest on the umbonal portion, measure from 2 to 2 1-2 mm. from crest to crest.

Woodring[1] has recently described an Eocene *Clementia* from Colombia, as variety *vetula* of *dariena.* His figures show a more circular shell with nearly central beaks and umbos. It appears to be distinct from the Peruvian shell, an opinion shared by Woodring after comparison of Peruvian specimens with his Colombian shell. Woodring's form is however young, and comes from rocks of the same age as the Peruvian and it is possible that with more material from Colombia will show the shells to be the same or more closely allied.

Localities and Geologic Occurrences.—

Upper Middle Eocene, Restin formation, Negritos (very rare)
Upper Eocene, Saman formation, generally common throughout, Negritos, Talara, Caleto Sal, Casa Saman, Paita, etc.
Lower Oligocene, Chira formation, several localities in the Chira valley, Caleto Sal, etc.

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[1] Woodring, W. P., 1926, American Tertiary Mollusks of the Genus *Clementia* Prof. Paper 147-C, U. S. Geol. Survey, p, 33, pl. 14, figs. 1-4.

Middle Oligocene, Mancora formation, Mancora, Lagunitas, Chira valley, Punta Bravo, etc.

Upper Oligocene, Heath formation, Caleta Mero abundant, Chira valley, etc.

Clementia (Clementia) parinensis, n. sp. Plate 7, figs. 3, 4

Shell small, inequilateral with the beaks quite close to the anterior extremity and with the greatest height of the shell near the middle; posterior extremity subtruncate, the ventral margin evenly rounded and with a relatively short anterior extremity; dorsal margin or slightly arched and apparently grooved near the hinge line; convexity moderate; but varying somewhat in different individuals; no defined lunule; the surface sculpture is Clementoid consisting of strong, concentric waves, regular on the umbos, but gradually disappearing ventrally and becoming indistinguishable from the growth lines; where best developed, the concentric waves or ribs, measure about one millimeter from crest to crest; the whole surface is covered with fine growth lines or threads strongest near the basal margin; interior concealed.

Length 27.5mm; height 22.75mm; diameter 14.5mm;

Remarks.— This is a small but very distinct species, its surface sculptured with typical Clementoid concentric waves and ribs, but varying somewhat in coarseness on different individuals. The posterior extremity is noticeably truncate and the posterior-dorsal submargins grooved or concave. It is a very characteristic species of the Parinas and Restin formation, and thus stratigraphically appears to be the oldest of the true Clementias of the Peruvian section.

Localities and Geologic Occurrences.—

Middle Middle Eocene, Parinas formation, Parinas and Balcones Points, Keswick Hills, Cabo Blanco, etc.

Upper Middle Eocene, Restin formation, Restin, Jabonillal, Negritos.

Clementia (Clementia) restinensis, n. sp. Plate 7, fig. 5, 6

Shell small to medium-sized, inequilateral, ovate-elliptical in form; beaks small and nearly touching, situated quite close to the anterior extremity; the dorsal margin is straight or slightly arched, the ventral margin evenly rounded and passing smoothly into the more acutely, rounded anterior and posterior extremities; there is no defined lunule or escutcheon; surface smooth or sculptured simply with the growth-lines which are somewhat coarser on the anterior and posterior extremeties and towards the basal margin.

Length 42mm; height 35mm; diamete 19.5mm; (type)

Remarks.— The internal characters are concealed. In shape, the shell resembles certain species of *Macrocallista,* but the beaks are more anteriorly situated and there is no lunule or escutcheon. In these features, the fossil resembles closely *Clementia* and probably belongs to that genus. They differ from most species of *Clementia,* in lacking the concentric, characteristic Clementoid waves or ribs and the surface of the shell is nearly smooth.

Localities and Geologic Occurrences.— Restin formation, Pozo valley near Lagunitas, Restin.

Genus GRATELOUPIA Desmoulins

Subgenus GRATELOUPIA s. s.

Grateloupia (Grateloupia) peruviana, n. sp. Plate 8, figs. 2, 5

Shell small or medium size, nearly equilateral; in form the shell is Mulinoid or that of a small *Iphigenia;* moderately convex, greatest about the center of the shell, midway between the nearly equal and similar anterior and posterior extremities; ventral margin widely rounded or curved and slightly flexed in the posterior-ventral region; dorsal margin straight or nearly so, sloping to form a bluntly pointed, posterior extremity and a more rounded anterior extremity; beaks very small, inconspicuous and closely adjacent; lunular area depressed, narrowly lanceolate and defined from the rest of the shell by a deeply impressed line; surface smooth or only faintly marked by the growth lines; hinge of right valve show two strong cardinals followed posteriorly by a wide nymphal area which includes the fused third cardinal; other internal characters concealed in the matrix.

Length 26mm; height 19.5mm; semidiameter 6.50mm;

Remarks.— Although this is a common species in the Parinas sandstone, the internal characters are difficult to determine, as the shells are most generally found enclosed in a hard sandy matrix. A single right valve collected, shows two evident cardinal teeth, followed on the posterior side by a wide nymphal area which probably includes the fused third cardinal. In this character, the hinge agrees with *Grateloupia,* typified in the Mulinoid or *Iphigenia*-like shape. The true *Grateloupia,* typified by *Donax irregulari* Basterot (*Grateloupia doniciformis* Desm.) have previously been recorded only from the European Miocene where they are found in the Aquitanian and Vienna basins and in the Italian Piedmont.

Localities and Geologic Occurrences.— Parinas formation, Parinas and Balcones Points.

Genus MACROCALLISTA Meek

Macrocallista inca, n. sp. Plate 8, figs. 1, 4

Shell of medium size, elongate or elliptical in shape, the greatest height of the shell being about midway between the anterior and posterior extremities; beaks rather small and near the anterior one-fifth and one-sixth; convexity of the shell is moderate, greatest in the dorsal umbonal region, and below which the shell is slightly impressed along a band extending from the beaks towards the posterior ventral margin; basal and dorsal margins well rounded, anterior extremity slightly produced, bounded above by the straight or slightly curved lunular margin; the exterior of the shell is smooth or porcellaneous, marked simply by fine growth lines; internal characters concealed.

Height 41mm; length 64mm; diamoter 26mm;
33mm; length 52mm; diameter 17mm;

Locality and Occurrence.— Saman formation, Saman sandstones of Casa Saman, Chira Valley.

Genus PITARIA Rœmer

Subgenus PITARIA Rœmer

Section PITARIA s. s.

Pitaria (Pitaria) sciæna, n. sp. Plate 7, figs. 8, 9

Shell small to medium size, porcellaneous, subequilateral, with high and nearly central umbos; anterior and posterior extremities nearly equally rounded or the posterior slightly more pointed; the shell is moderately convex, with wide, full umbos and with small, scarcely prosogyrate beaks; lunule elongate-lanceolate and defined by a fine, impressed line; escutcheon not differentiated; the surface is smooth or marked only with growth lines, strongest on the older shell and along the posterior dorsal slope.

Length 34mm; height 27mm; semidiameter 9mm;

Remarks.— A fairly common species in the Pale Gredas of Restin. It differs from *M. bosworthii* and *negritosensis* Woods by its much smaller size.

Locality and Geologic Occurrence.— Pale Greda formation, Restin.

Subgenus HYSTEROCONCHA Fischer

Section LAMELLICONCHA Dall

Pitaria (Lamelliconcha) negritensis, n. sp. Plate 8, fig. 3

Shell small to medium size, ovate-eliptical; beaks near the anterior one-third and with the greatest height of the shell in this region, the dorsal margin is slightly arched or straight, descending towards the posterior extremity which appears obliquely subtruncate; the anterior extremity appears somewhat produced with a straight lunular margin and a rounded basal margin; lunule narrowly lanceolate; sculpture consists of concentric bands developed on the umbos, the anterior submargins and the posterior-dorsal slopes but they are lacking from the center of the shell-disk, where the surface is smooth and polished; on the anterior submargins and the umbonal slopes, the concentric bands become rounded ridges, with deep, narrow interspaces; hinge of left valve shows three cardinal teeth and one anterior lateral; pallial sinus not evident in our specimens; ventral margin smooth.

Length 36.5mm; height 24mm; diameter 12.5mm;

Remarks.— The type specimen is somewhat crushed so that the posterior extremity appears to be more pointed than it actually is in nature. The shell has the general features of *Macrocallista* and probably should be referred to that genus, rather than *Pitaria.* It is distinguished from allied species by its sculpture, which is obsolete from the center of the shell disk. The *M. Dickersoni* Wood is quite common in the Clavilithes beds. It differs by its smoothly elliptical and convex form and even regular concentric sculpture.

Locality and Geological Occurrence.— Negritos formation, Negritos.

Pitaria (Lamelliconcha) parinensis, n. sp. Plate 8, figs. 6, 8

Shell small, ovate-elliptical, inequilateral and with the beaks near the anterior one-third; convexity of shell moderate or slight basal margin rounded or slightly flexed or emarginated posteriorly; posterior dorsal margin straight and with a bluntly pointed anterior and posterior extremity; lunule small, lanceolate and deeply sunken; surface sculpture of fine, regular, narrow ribs or ridges, spaced about three-fifths of a millimeter apart on the shell disc; they number about 35 on the type specimen; interspaces very wide and marked by 2, 3 or more coarse growth lines; interior concealed by the matrix.

Length 24mm; height 16.5mm; semidiameter 5mm;

Remarks.— This is a small species quite common in the Parinas sandstones. From the *P. saponaria* of the Restin formation, this species is recognised by its smaller size, finer sculpture and flexing of its posterior ventral margin.

Localties and Geological Occurrence.— Parinas formation, Keswick, Hills and Balcones Point.

Pitaria (Lamelliconcha) saponaria, n. sp. Plate 8, fig. 11

Shell small, ovate-elliptical, inequilateral, moderately convex, and with the beaks situated near the anterior one-third; lunule small, lanceolate; basal margin broadly curved, passing into the bluntly pointed posterior extremity; surface sculptured with even, narrow, concentric ribs or ridges, rounded on top; the concentic ribs number about 34 on the type specimen and are spaced about three-fourths mm. apart on the center of the shell disc, and separated by deep, flat interspaces, nearly twice as wide; the ribs and interspaces are finely marked by the concentric growth lines interior largely concealed in the type specimen, a fragment of the left valve shows a strong lateral tooth and three cardinals.

Length 27mm; height 18mm; semidiameter 6mm;

Remarks.— A rare species represented in our collection by the type and two fragmentary specimens. It is recognized by its even and rather coarse concentric sculpture.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Pitaria (Lamelliconcha) salsola, n. sp. Plate 8, fig. 7

Shell of moderate size, elliptical, inequilateral, with the beaks near the anterior third; convexity of shell slight; basal margin well rounded on the anterior half, becoming slightly rounded or nearly straight on the posterior half and slightly flexed just in front of the posterior dorsal umbonal slope; dorsal margin is straight or nearly so, with the posterior extremity slightly rounded or subtruncate; the anterior extremity appears somewhat produced and bounded above by the concave lunular margin; surface of shell is marked with a close sculpture of concentric ribs or bands, generally evenly spaced, but sometimes becoming crowded and marking resting stages in the development of the shell; these bands are separated simply by incised or impressed lines; hinge characters concealed, but molds of the interior show a large, pallial sinus, extending to and slightly behind the middle of the shell.

Length 33mm; height 20mm; semidiameter 5mm;

Remarks.— Recognized by its elongate form, slight flexing of its posterior-ventral margin and its close-set sculpture of concentric bands, divided simply by incised lines. It belongs in the horizon of the Saman conglomerate.

Locality and Geologic Occurrence.— Saman formation, Salina, near Negritos.

Pitaria (Lamelliconcha) samanensis, n. sp. Plate 8, fig. 9

Shell of moderate size, ovate, inequilateral with the beaks about the anterior third; convexity very slight and the shell appearing nearly depressed; basal margin slightly rounded, a pointed posterior extremity and a well rounded anterior extremity; dorsal margin slightly convex or arched midway between the beaks and the posterior extremity; surface sculpture of regular, and rather coarse, concentric ribs or ridges, seemingly reflexed or inclined dorsally; the ribs are spaced nearly a millimeter apart on the shell disk and number about 40 or more on an average specimen; interior concealed.

Length 36mm; height 26mm; diameter 12mm;

Remarks.— A fairly common species in the Upper Saman rocks but good specimens have not been obtained. It differs from the previously described species by its more pointed, shorter and ovate shaped shell.

Locality and Geologic Occurrance.— Saman formation, Casa Saman.

Section TIVELINA Cossmann

Pitaria (Tivelina) siliqua, n. sp. Plate 8, figs. 12-14

Shell small, inequilateral and moderately heavy; shape subtrigonal, with the beaks near the anterior fourth, small, pointed, adjacent and slightly curved anteriorly; basal margin broadly rounded passing into a pointed or bluntly rounded posterior extremity; the valves are slightly flexed along a line just anterior to the posterior dorsal slope; anterior extremity short and narrowly rounded and passing into the lunular margin which is straight; convexity moderate; lunular area broadly elliptical; surface somewhat rough and sculptured simply by the growth lines, heavier along the posterior-dorsal slope and towards the margin; interior concealed.

Length 20mm; hieght 16.5mm; diameter 11.5mm;

Remarks.— This is a small species distinguished by its pointed posterior extremity and general Nuculoid form. Its posterior portion is slightly flexed and the surface is marked with fairly coarse irregular growth lines. It probably belongs to *Tivelina,* Cossmann considered by Dall as a section of *Pitaria.*

Locality and Geologic Occurrence.— Negritos formation, Negritos.

Genus CALLOCARDIA A. Adams

Callocardia salvia, n. sp. Plate 8, fig. 10

Shell small or of moderate size; cordate, inflated, inequilateral, with beaks near the anterior fourth; umbos wide and full with fairly prominent and slightly prosogyrate beaks; lunule elliptical and on our specimens defined by a feeble impressed line; the basal margin is evenly rounded, passing into a broadly rounded or subtruncate posterior extremity, on one side and a somewhat pointed anterior extremity on the other; the exterior is sculptured simply by crowded growth lines and the surface of the shell is slightly rough to the touch; hinge of the right valve shows a socket for the left lateral and three cardinal teeth, the middle one bifid; the posterior-dorsal margin grooved.

Length 33mm; height 26.5mm; diameter 19mm;

Remarks.— This species resembles somewhat the *Pitaria csiæna,* but differs by its more inequilateral shell and by its more curved beaks. The type specimens are from the top of the

Salina formation, but the species continues into the Parinas sandstones.

In the lower Saman shales near Negritos, there are small shells scarcely distinguishable from the typical *C. salvia.* Judging by our collection, these shells are smaller, and somewhat longer, characters are recognized of very minor value. Since they occur at a much higher horizon, these characters may be of greater importance than they would seem at first, and for this reason, this form may be separated as variety *gemma.*

Superfamily TELLINACEA Blainville

Family TELLINIDÆ Deshayes

Genus MACOMA Leach

Subgenus PSAMMACOMA Dall

Macoma (Psammacoma) talarensis, n. sp. Plate 9, fig. 6

Shell thin, elongate-ovate, moderately convex, equivalve, with an outline suggestive of *Periploma;* anterior side rather long, wide, the posterior side shorter and contracted to about one-half the height of the anterior and less than one-half as long; umbos wide but not prominent with small beaks, situated about the anterior 2/3rds; the ventral margin is evenly rounded; the anterior-dorsal margin straight, the posterior-dorsal margin strongly descending and concave upward; the anterior extremity is broadly rounded, the posterior subtruncate; the posterior side is weakly flexed by two subobsolete folds, one lying along the umbonal slope, paralleled posteriorly by a faint sinus and this in turn by a second faint fold; shell very thin, with a nearly smooth surface.

Length 24mm; height 15mm; semidiameter 3.5mm;

Remarks.— The internal characters are concealed and the reference of the shell to *Macoma* is based on external resemblance. The shell is extremely thin and in form resembles certain species of *Periploma.* The *Tellina formosa* Philippi from Lebu Chile is very similar in general form to the Talara shell, but is larger (55 mm.), higher and with the ventral margin more strongly rounded.

Locality and Geologic Occurrence.— Saman formation, Talara.

Family DONACIDÆ Deshayes

Genus DONAX Linné

Subgenus DONAX s. s.

Donax (Donax) parinensis, n. sp. Plate 9, fig. 3

Shell of the usual size for the species of the genus, elongate-subtrigonal, solid, a strong posterior truncation and a fairly heavy radial sculpture; posterior extremity very short, sharply truncate so that the plane of its surface is almost perpendicular with that of the adjacent surface of the shell; anterior end much longer, cuneate and with the extremity narrowly rounded; ventral margin evenly rounded but somewhat arched or vaulted in the middle by a broad fold extending from the beak and over the umbonal region; anterior-dorsal margin straight; anterior-dorsal submargin excavated and smooth; the shell is moderately convex with a broad fold extending ventrally across the umbo, and bordered on each side by a depressed band; surface sculpture consists of rather strong, radial ribs, sometimes crenulated by concentric lines; the radial ribs are very fine on the posterior truncation, while on the general surface of the shell, they are flat and low over most of the anterior portion, but become strong and rounded in contour from about the center and across the depressed band to the posterior-umbonal angle; on the anterior portion, the flat ribs may be finely crenulated by incised concentric lines; internal margin sharply crenulated.

Length 21mm; height 15mm; semidiameter 5.75mm;

Remarks.— This is a true *Donax,* with a strongly truncated posterior side, rather heavy sculpture of radial ribs and a serrated or crenulated margin. The single type specimen was collected in the Parinas sandstones of Keswick Hills three or four miles east of Negritos.

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Section LATONA Schumacher

Donax (Latona) prosopsis n. sp. Plate 9, fig. 2

Shell elongate or donaciform, thick, the anterior side long, the posterior side much shorter and about 1/3rd the length of the whole shell; the shell is slightly convex, the greatest inflation being along the umbonal ridge a short distance in front and below the beak; ventral and dorsal margins straight but not quite parallel; the anterior extremity is straight or subtruncate, meeting the ventral margin at slightly less than 90 degrees; the posterior portion of the shell is strongly depressed or flattened and with a strong umbonal angle, extending from the beak to the posterior-ventral margin; the surface of the shell is smooth or slightly roughened by irregular growth lines, heaviest on the anterior portion; there are faint indications of radiating lines or striæ on the posterior portion of the shell; the hinge margin appears to have been smooth.

Length 31.5mm; height 17mm; semidiameter 5.5mm;

Remarks.— This species is provisionally referred to the Section *Latona* Schumacher, but in most of the recent species of this group, the umbonal angle is less prominent, and the posterior slope is generally quite strongly sculptured with radial striæ.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Donax (Latona) capparis, n. sp. Plate 9, fig. 7

Shell donaciform, elongate-subtrigonal, with a strong, posterior truncation, and a longer anterior end; beaks small, situated about the anterior 2/3rds; ventral margin evenly rounded; the anterior-dorsal margin is straight and descending, meeting with the ventral margin to form a narrowly rounded anterior extremity; the posterior side is straight, meeting the ventral margin at an angle of less than 90 degrees; umbonal slope is angled but not carinate; surface smooth; the ventral margin was probably smooth.

Length 33mm; height 21.5mm; diameter 11mm;

Remarks.— From the preceding species, to which this shell is obviously related, it will be distinguished by its more typical *Donax*-like form and more trigonal outlines. Its surface is plain and smooth. The ventral margin appears to have been smooth.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Superfamily MACTRACEA Gray

Family MACTRIDÆ Gray

Genus SPISULA Gray

Subgenus SPISULA s. s.

Spisula (Spisula) caleta, n. sp. Plate 10, fig. 1

Shell of moderate size, very thin, nearly equilateral, moderately inflated, smooth; form as figured is broadly subtriangular with a smoothly rounded ventral margin, and with the dorsal margin straight on the posterior side but concave on the anterior; umbos prominent central, with conspicuous and closely adjacent beaks; the posterior-dorsal submargins is generally a little convex towards the posterior side but becoming concave nearer the beaks and generally carrying two or more obscure, radiating folds or ribs, one of which forms the rounded, umbonal angle; anterior-dorsal margins concave and deep; surface smooth or simply sculptured by the growth lines; interior concealed.

Height 48mm; length 57mm; semidiameter 25.5mm;

Remarks.— The hinge of this fine species is not preserved in our specimens, but the general form of the shell is that of a typical *Spisula* and may be paralleled by any number of species in the recent and Tertiary faunas. The texture of the shell is extremely thin and in most of the fossils, it is preserved in thin tissue paper-like patches or when weathered as a soft chalky covering.

The *S. decisa* Conrad from the Claibornian of Alabama and Louisiana is similar to the present species, but is proportionately longer and heavier.

Locality and Geologic Occurrence.— Saman formation, Caleta Sal.

Spisula summa n. sp. Plate 10, figs. 5, 6

Shell of medium size, subtriangular, convex and nearly equilateral; umbos wide but not very prominent, and with the beaks situated a little anterior of the middle; umbonal slope angled but not sharply, and with the posterior-dorsal submargins rather wide, and slightly vaulted or convex; the anterior submargin is wide and slightly concave; ventral margin evenly but not strongly rounded, with the anterior extremity narrowly rounded and the posterior subtruncate; surface is smooth or marked only by the growth lines but with the anterior-dorsal submargins more finely sculptured with even, regular lines; hinge imperfectly preserved in our specimens, shows two strong laterals, a V shaped cardinal and a resilium pit.

Length 44mm. broken; height 44mm.; semi-diameter 17mm. holotype
49mm.; height 42mm.; semi-diameter 15mm.

Remarks.— The type specimens come from the Pale Gredas of Restin and their average size is about 44mm. in height. They are similar in general characters to specimens in our collection from the Salina formation near Negritos, with exception that the umbos are somewhat higher and wider. What is likely the same species or a closely allied form occurs in the Restin formation at Jabonillal, where the largest specimens reach a height of about 58mm.

From the *S. caleta,* this species is distinguished by its heavier shell, its wide but less prominent umbos and general Mulinoid form.

Localities and Geologic Occurrence.— Salinas formation, Negritos. Pale Greda formation, Restin. Restin formation, Jabonillal.

Spisula (Spisula) hualtaca n. sp. Plate 9, fig. 4

Shell elongate-subovate, nearly equilateral, depressed or but little convex; form as figured, with the height approximately three-fifths of the length, the umbos low and depressed and with small, erect pointed beaks, situated about the middle of the shell; anterior and posterior sides subequal, that of the anterior side slightly the longer and with the dorsal margin somewhat contracted; ventral margin is broadly rounded, the dorsal-posterior margin vaulted or nearly straight; the posterior extremity is rounded that of the anterior extremity more narrowly rounded; shell was probably very thin in texture.

Length 44mm.; height 26mm.; semi-diameter 4.5mm.

Remarks.— The species is based on a single internal cast ot the right valve from the Saman shales of Caleta Sal. It differs from the other Peruvian Mactroids, in its more elongate form and strongly depressed shell. The beaks are low, nearly central, and the umbos flat and depressed. The texture of the shell was probably thin and smooth, without any indication of concentric plicæ such as occur on the ventral portion of the shell in *Spisula callistoides* and *deserta.* The pallial sinus is faintly indicated on the specimen. It appears to have been of moderate size, open, wide and reaching not quite to the center of the shell.

Locality and Geologic Occurrence.— Saman formation, Caleta Sal.

Subgenus HEMIMACTRA Swainson

Section OXYPERAS Morch

The section *Oxyperas*[12] with *S. ariangularis* Lam. as its type species, is chiefly of Indo-Pacific distribution. The shells are typically triangular in shape and the surface of the valves is ornamented with strong, concentric plicæ. This section is well represented in the Peruvian Tertiaries by several typical species.

Spisula (Oxyperas) callistoides n. sp. Plate 10, figs. 3, 4

Shell of medium size, nearly equilateral convex; the form as figured is broadly subtriangular, with the height about two-thirds that of the length; ventral margin is slightly rounded with a bluntly pointed posterior extremity and a narrowly rounded anterior extremity; the dorsal margins are straight and bordered on each side of the beaks by wide, flat submargins; the umbonal slope is angled or with a low fold, below which the shell carries a faint concave band or sinus towards the ventral margin; the umbos are wide and prominent. with conspicuous beaks; surface of shell appears to be generally smooth on the umbos but becoming strongly plicate or sculptured with regular concentric ribs towards the basal margin or covering an area approximately the lower one-third; these concentric ribs number generally between 8 to 10 and are sufficiently heavy to extend through the shell and to be impressed upon the internal moulds; the posterior dorsal submargins are smooth, while the anterior-dorsal submargins are sculptured over the whole area by fine, regular, concentric threads or fine ridges; interior concealed.

Length 54mm.; height 34.5mm.; diameter 28mm.

Remarks.— This species is fairly abundant in the Saman sandstones of the Chira Valley. In form and general characters, it approaches closely the *S. triangularis* Lamarck, a recent species and the type of *Oxyperas.* There are 3 or 4 recent species of *Oxyperas,* distributed mainly in the western Pacific region, from New Zealand north to Japan.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Spisula (Oxyperas) deserta n. sp. Plate 10, figs. 2, 7

Shell small, nearly equilateral, moderately convex; shape is broadly triangular or hatchet-shaped, the height somewhat less than the length, and with the beaks and umbos more or less centrally placed; ventral margin smoothly rounded with straight dorsal margins, descending from the beak to form the nearly equally rounded anterior and posterior extremities; the umbonal slope is rounded or with a faint fold and bordered on the hinge side by wide and slightly convex submargins; surface is smooth on the umbos but becoming plicate or sculptured with regular and fairly coarse, concentric ribs on the ventral one-third; the concentric ribs number 8 to 10, are rounded and separated by deep grooves, and become replaced on the anterior submargins by finer ribs; a faint sinus parallels the umbonal angle and extends from the beak to the posterior ventral margins; interior concealed.

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[12] See Ed Lamy, 1917, Revision de Mactridæ Vivants, Journ de Conchyl. vol. 63, p. 323, pl. 7, fig. 1.

Length 28.5mm.; height 27.5mm.; semi-diameter 8mm.

Remarks.— From *S. callistoides,* this species differs by its smaller size, higher shell and somewhat finer sculpture. It occurs in a hard ferruginous sandstone layer, associated with *Spisula caleta, Amotapus arbolensis,* etc., in the Saman shales of Caleta Sal.

Locality and Geologic Occurrence.— Saman formation, Caleta Sal.

Spisula (Oxyperas) parinensis n. sp. **Plate 9, fig. 5**

Shell small, convex or moderately inflated, subtriangular; umbos high and prominent with pointed, conspicuous and central beaks; ventral margin slightly rounded and usually indented or flexed towards the posterior extremity; the umbonal slope is weakly angled and bordered on the hinge side by the slightly convex and vaulted submargins; the anterior dorsal submargin is concave or excavated greatest immediately in front of the beak; the anterior extremity is somewhat produced and narrowly rounded, the posterior more broadly rounded; surface of shell is smooth on the umbonal portion, but towards the basal or ventral margin becoming sculptured with fine, regular, incised lines; on the hinge side of the anterior-dorsal submargins, the surface is often sculptured with heavy concentric ribs, divided by deeper incised lines; hinge concealed.

Length 16.5mm.; height 11.5mm.; semi-diameter 4mm.

Remarks.— This is a small species locally common in the Parinas sandstones and the Saman conglomerate, the average length of specimens collected being about 15mm. At first it might be suspected to be the young of *S. deserta* of Caleta Sal, but differs by its constant smaller size and more produced anterior extremity. Its sculpture is also finer.

Localities and Geologic Occurrence.— Parinas formation, Balcones Point. Saman formation, Salina, near Negritos.

Superfamily MYACEA Menke

Family CORBULIDÆ Fleming

Genus CORBULA Lamarck

The genus *Corbula* is represented in the Peruvian Tertiaries by numerous species. Four species were described by Woods from Eocene rocks, namely the C. *arnoldi, waringi, peruviana* and *parinasensis,* the three former from the *Turritella series* or restricted Negritos formation, and the last species from the Parinas sandstones. The *C. parinasensis* is a large, fairly smooth and nearly equivalved form, which becomes more common and larger in the Restin formation. Several additional species are described in this paper, but others are represented in our collection, but too imperfectly preserved for description.

There is some confusion amongst authorities as to the type species to be selected for the genus *Corbula.* In 1847, Gray selected the *C. sulcata* Lamarck, as the type species, and most European authors and others have followed this usage. Dall however points out that this species was earlier used as the sole example of Muhlfeldt for *Aloidis* and must be retained for the section of the genus typified by that species. Dall therefore selected as the type species, the *C. gallica* Lamarck a species used by Fischer as the type for his section *Bicorbula.*

In Dall's classification of the *Corbulidæ,* most of the Peruvian species would belong in the Section *Cuneocorbula* of Cossmann, but the type *C. biangulata* Deshayes of the Parisien Eocene is bicarinate and quite different from the American shells usually placed in that section.

The Restin species, described here as *C. bursera,* differs widely from any described Corbulas of which we have found record. The hinge is unknown but its external characters are so peculiar that a new section *Cuspicorbula,* named for its likeness to *Cuspidaria,* is proposed for its reception.

Section CORBULA sensu lato

Corbula negritensis n. sp. Plate 11, figs. 3, 4

Shell of medium size, solid, nearly equilateral and equivalve; form as figured is broadly elongate, the posterior extremity is rostrate and slightly longer; umbos wide but not prominent, with small inconspicuous beaks; posterior end subtruncate, with a strong angle or keel on the rostrum; both valves similarly sculptured with strong, concentric ribs, nearly equal on the lower half of the shell, smaller and fainter on the umbos; the ribs number 12 or more subtriangular in section and the interspaces V shaped, the rostral area is smooth or sculptured with irregular growth lines; there is a finer, submicroscopic sculpture of radial threads in lines, covering the ribs and interspaces alike; interior concealed.

Length 11mm.; height 8mm.; diameter 5.5mm.

Remarks.— The *Corbula aulacophora* Morelet, from the Bartonian French Eocene is similarly sculptured but more inequilateral and pointed posteriorly. The species also resembles the *C. sphenia* Dall from the Chipola Miocene but is only half as large.

Locality and Geologic Occurrence.— Negritos formation, Negritos.

Corbula boggsi n. sp. Plate 11, figs. 18, 20

Shell small, solid, inflated, with nearly central beaks and umbos, and similar sculpture on both valves; the right valve is nearly equilateral and somewhat larger than the left, its posterior side carrying a short rostral carina and a slight emargination or fold along the ventral margin; the left valve is inequilateral oblique with a short posterior end, provided with a rostral angle and truncated at its extremity; the anterior end is wide, with sloping dorsal margin and rounded extremity; ventral margin flattened or contracted; sculpture consists of 12 or more, subregular, concentric ribs or waves, absent from the umbos which are smooth; the rostral area is smooth; interior concealed.

Length 8mm.; height 6mm.; diameter 5.5mm.

A smaller and shorter species than the preceding, recognized by its oblique shell and fine sculpture. It is abundant in the horizon of the Saman conglomerate.

Locality and Geologic Occurrence.— Saman formation, Negritos.

Corbula salina n. sp. Plate 11, fig. 15

Shell small, irregular, strongly twisted or rostrate behind and strongly sculptured with few, coarse, concentric ribs; right valve sub-equilateral with nearly central beaks and wide umbos, a rounded anterior end and a shorter, rostrate or pointed posterior end; the right valve is slightly larger than the left, and with the posterior portion of the ventral margin, widely overlapping the left valve; the left valve is inequilateral, oblique, with the anterior end very long and wide, and with a short, angled posterior end; the rostral area is produced, somewhat twisted, concave above; the ventral margin is rounded that of the right valve widely embracing the left along the posterior side; sculpture consists of 12 or 13, regular but somewhat wavy, concentric ribs, strongly developed over the whole surface and they may continue across the rostral area of the right valve; interior concealed.

Length 7.5mm.; height 4.5mm.; diameter 3.5mm.

Remarks.— This is a small and common species in the Saman conglomerate and may be recognized by its coarse, heavy sculpture.

Locality and Geologic Occurrence.— Saman formation, Negritos.

Corbula greda n. sp. Plate 11, figs. 13, 14

Shell, small, convex, elongate-ovate, widest about the anterior portion, rostrate behind and delicately sculptured; right valve inequilateral but with nearly central beaks and most strongly convex about the anterior one-fourth; the posterior side is shorter, rostrate, obliquely truncated but pointed and twisted at its extremity; left valve is similar but smaller and slightly embraced by the right valve, along the posterior ventral margin; posterior portion of each valve with a rostral angle or keel, strongest towards the extremities; the surface is sculptured with fine regular concentric threads or small ribs, similar on both valves; interior concealed.

Length 6.5mm.; height 4mm.; diameter 3.5mm.

Remarks.— A small delicately sculptured species common in the Upper Restin shales and sandstones at Jabonillal where it occurs associated with *Corbula parinasensis* and *jabonillænsis.* It is the smallest species known from the Peruvian Tertiaries, the largest specimens in our collection, measuring about 6 1-2mm.

Locality and Geologic Occurrence.— Restin formation, Jabonillal

Corbula jabonillænsis n. sp. Plate 11, figs. 11, 12

Shell of medium size, thin, equivalve, elongate-ovate, convex, strongly keeled; valves nearly similar in shape and sculpture, the right valve slightly the larger; beaks slightly posterior to the middle and with the greatest convexity about the center and with a faint sinus or depressed band extending from the beaks to the ventral margin; ventral and dorsal margins straight and nearly parallel with a well-rounded anterior end and a pointed and strongly keeled posterior end; the rostral angle is sharply keeled, bordered above by a concave rostral area on each valve; the sculpture consists of fine, sharp, regular, concentric threads, similar over the whole shell; interior concealed.

Length 12mm.; height 7.75mm.; diameter 4.5mm.

This is a rare species from the Upper Restin of Jabonillal. It is closely paralled in the recent fauna by *C.* probably *bicarinata* Sby of the Peruvian coast, the two species being similarly sculptured and with the rostral angle sharply keeled. In the recent species, there is a second keel bordering the hinge margin and enclosing a smooth, elongate, escutcheon-like area along the hinge margin. In the Jabonillal shell, this part of the valve has been destroyed by weathering.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Corbula tangara n. sp. Plate 11, figs. 9, 10

Shell of medium size, solid, strongly inflated with a pointed and somewhat twisted posterior end; both valves nearly equal in size and strongly convex, the right valve developing a depressed band or broad sinus towards the posterior ventral margin, which more or less overlaps the ventral margin of the left valve; umbos very wide, with very small, central and inconspicuous beaks; anterior end is broadly rounded and convex, with the dorsal and ventral margins sloping to form the pointed and somewhat twisted, and rostrate posterior end; the rostral angle is generally weak, except towards the extreme posterior end; surface sculptured similarly on both valves with 35 or more, fine, regular, concentric ribs, which are generally lacking on the umbos; the sculpture of the left valve is usually a little weaker and the ventral portion of the shell may be nearly smooth; on the right valve, the sculpture parellels the curve of the ventral margin; no lunule; interior concealed.

Length 14mm.; height 9.5mm.; diameter 10.25mm.

This is a common species in the Saman rocks, recognized by its very tumid or inflated shell. Both valves are sculptured similarly with fine, concentric ribs which follow the contour of the ventral margin of the valves.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Section CUSPICORBULA n. sec.

The following is a description of the Section *Cuspicorbula* type *C. busera* n. sp.

Shell ovate, solid, both valves strongly and nearly equally convex; the posterior end is abruptly contracted or constricted by a deep sinus, extending from the umbonal region, across the ventral or basal margin; lunular area deep; sculpture consists of strong, concentric ribs on the right valve, less heavy on the left; hinge unknown.

Corbula (Cuspicorbula) busera n. sp. Plate 11, figs. 5, 8

Shell small or medium-sized, solid, inflated, coarsely sculptured and with the posterior extremity strongly contracted and rostrate; the anterior and central portion of the valves is strongly convex or inflated, oblique, with a deep, wide, cordate lunular area in front and below the beaks; the posterior end is strongly contracted into a short, rostrate portion by a deep sinus, directed towards the left from the central and anterior part of the shell, and the general form of the shell is suggestive of a *Cuspidaria;* the right valve is slightly larger than the left and less strongly sculptured; sculpture of the right valve consists of about 10 or 12 coarse, concentric ribs, separated by wide interspaces, and these ribs are continued across the posterior sinus to the posterior extremity; on the umbos, this sculpture is generally much finer; the sculpture of the left valve is similar to the right but finer; interior concealed.

Length 13mm.; height 9.5mm.; diameter 9.25mm.

Locality and Geologic Occurrence.— Restin formation, Restin.

Class GASTROPODA

Subclass STREPTONEURA

Order CTENOBRANCHIATA Schweigger

Superfamily PTENOGLOSSA Gray

Family EPITONIIDÆ Dall

Genus EPITONIUM Bolten

Subgenus ACRILLA

Epitonium (Acrilla) peruvianum n. sp. Plate 12, figs. 10, 12

Shell small, very slender and with numerous slowly tapering whorls; the whorls are strongly convex and firmly united by close sutures; varices are delicate, narrow, porcellaneous and smooth, oblique to the general axis of the shell and inclined down towards the right; the varices number about 18 on an average size whorl, have no regular arrangement with respect to the adjacent whorls, and only through coincidence on certain specimens, do they appear continuous across the sutures or from whorl to whorl; the intervarical spaces are much wider, excavated or concave and usually darker in color than the varices themselves; the intervarical spaces are finely sculptured with fine, sub-microscopic spiral striæ; a thin basal disc is present, crossed by the varices to the umbilical region, and also sculptured by the spiral striæ; mouth circular, with a thin or weak lip and a probably discontinuous peristome; umbilicus closed.

Length 14mm.; diameter 4.5mm.; (5 1-2 whorls)

Remarks.— All our specimens of this species are fragmentary, lacking the apical and apertural whorls. The shell is very long or slender, with numerous, slowly tapering whorls. It is finely sculptured with narrow, smooth and rounded varices and the interspaces with fine, microscopic spiral striæ. In exceptional well-preserved specimens, the intervarical spaces may also show fine, longitudinal lines, so that the resulting sculpture appears minutely trellised or shagreened. A thin, basal disc is present, similarly sculptured with varices and fine spiral striæ.

This species is very characteristic of the horizon of the Saman conglomerate, and although always fragmentary, it is recognized by its delicate and beautiful sculpture. Our collection contains fragments of a second species, similar in most respects to *E. peruvianum*, but with much heavier spiral striæ.

Localities and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate, south of Negritos, Pozo.

Family SOLARIIDÆ Chenu

Genus ARCHITECTONICA Bolten

Architectonica sullana n. sp. Plate 12, figs. 1, 2

Shell rather large for the species of the genus, moderately elevated and deeply umbilicate; whorls about 6 in number, each slightly convex in profile; young shells are generally depressed but with growth become proportionately higher and the spire angle steeper; periphery of the whorl is strongly carinated by a heavy, smooth, spiral cord, which is bordered on the upper surface by a second, smooth cord, the two usually following closely, the course of the sutures on the earlier whorls (this is a variable character and some shells, have only a single sutural carina or none at all) ; on the lower surface, the peripheral cord is bordered by a smaller, smooth cord and an intervening deep, spiral groove; with exception of the above spiral sculpture, the surface of the shell is smooth except for the growth lines; the umbilicus is wide, scalar and deep, the umbical angle is strongly nodulated with about 26, strong teeth; the umbilical wall of each whorl is straight, with a single, strong, smooth, spiral rib.

Height 24.5mm.; diameter 43mm.

Remarks.— This is a large species for the genus, the type specimen selected coming from the Saman sandstones of the Chira Valley and has a diameter of about 43 mm. It appears for the first time in the Saman formation, and continues into the overlying Oligocene, as high as the lower part of the Heath formation. The shells are generally large but usually badly broken. In the Restin, the larger specimens of *A. nelsoni* may resemble the present species, and it is evident on closer study that *A. nelsoni* was probably the percursor of *A. sullana.* Continued evolution has resulted in the development of nearly smooth whorls, a nodulated umbilical angle and a ridge or rib on the umbilical wall.

The surface of the whorls appear generally smooth, but on the better preserved parts of the shell, a faint indication of spiral lines may usually be seen. The periphery is strongly carnated in young shells, but in older individuals the peripheral cords may become subobsolete, and the peripheral edge of the whorls, more or less excavated and overhanging.

Localities and Geologic Occurrence.— Saman formation, common throughout, but especially at Casa Saman and Paita; Oligocene records will be given later.

Architectonica jabonillensis n. sp. Plate 12, figs. 6, 9

Shell small or medium sized, moderately elevated, and with a rounded periphery; whorls about 6, generally flat or slightly excavated; nucleus small, sinistral and immersed in the succeeding whorls; the periphery of the whorls is rounded and with the adjacent upper surface generally slightly excavated; upper surface of whorls sculptured with beaded spiral threads or cords which are strongest just in front of the sutures; the suture is bordered in front or below by a wide but not strong, beaded, spiral cord, and this in turn by 3, weaker beaded spirals, gradually diminishing in size, in a direction away from the suture; the surface of the whorl above the suture is usually excavated and ornamented simply by very fine spirals, either smooth or faintly beaded, and a small cord generally borders the suture on the posterior side; the lower surface of the last whorl is sculptured, much like the anterior portion of the upper surface, with simple spiral threads, increasing in size towards the umbilicus; the umbilicus is wide and deep, the umbilical angle strongly or subobsoletely modulated and the umbilical wall sculptured with simple spirals, two of which are slightly larger than the others, and which may represent the umbilical rib.

Greater diameter 19mm.; height 10mm.

Remarks.— This species is fairly abundant in the Upper Restin sandstones and shales of Jabonillal, associated with *A.*

nelsoni Woods. From *A. chiræensis*, this species differs by its more rounded periphery and finer sculpture.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Architectonica chiræensis n. sp. Plate 12 figs. 13, 14

Shell small or medium-sized, slight to moderately elevated spire with an angled or carinate periphery; whorls about 7, flat; nucleus small, sinistral, immersed; the periphery of the whorls is angled and strongly carinated by a beaded and heavy spiral cord; the sculpture of the upper surface of the whorls consists of about 6, beaded, spiral threads, the two bordering the upper suture and one on the lower suture being usually the strongest; the lower surface of the whorl carries about 6 spirals, the inner ones near the umbilicus being the heaviest and strongly nodulated or beaded, the others plain and smooth; the umbilical angle is strongly nodulated.

Greater diameter 22mm.; height 10.5mm.

Remarks.— This species like *A. sullana*, begins in the Saman Eocene and continues into the overlying Oligocene, the type specimens being selected from the Chira formation of the Lower Oligocene. Specimens from different localities show variation in the strength and beading of the spiral cords. In some cases, the beading is of limited development and part of the spirals may be smooth, while in other examples the spirals are coarsely beaded both on the lower and upper surface of the whorls.

Localities and Geologic Occurrence.— Saman formation, Casa Saman; Chira formation, Chira valley, loc. 168.

Family NATICIDÆ Forbes

Genus NATICA Scopoli

Subgenus NATICA s. s.

Natica (Natica) peruviana n. sp. Plate 13, figs. 6, 9, 10

Shell small, generally white, with a smooth shell and form such as typical of *Natica* s. s; diameter of shell somewhat less than the height with a large, inflated body-whorl, which is evenly convex and widest just above the middle; whorls 4 1/2 to 5, those of the spire convex or subangular midway between the close sutures; a fairly distinct flattened band borders the lower side of the upper suture, giving to the spire a more or less scalar aspect; the umbilicus is open, and provided with an internal rib; aperture, large, wide and semilunar, with a small callus above on the body-whorl; surface smooth, the flattened sutural band smooth but sometimes carrying very weak, oblique undulations.

Diameter 10mm.; height 9mm.

Remarks.— This species is a true *Natica,* with an open umbilicus furnished with an internal rib. The body-whorl is large and inflated, and the form of the shell is that of a very small *N. canrena* Linné, except that the flattened sutural band is smooth or only faintly wrinkled.

Locality and Geologic Occurrence.— Restin formation, Jabonillal; Saman formation, Horizon of the Saman conglomerate, near Negritos.

Genus POLINICES Montfort

Subgenus POLINICES s. s.

Polinices (Polinices) woodsi n. sp. Plate 13, fig. 1

Natica (*Naticina*) sp. Woods, 1922, p. 77, pl. 6, fig. 9, pl. 7, fig. 1.

Shell rather large, solid, the height somewhat greater than the width, with a large aperture and rather small, low spire; whorls about 5, the last very large and forming the greater part of the shell; the contour of the last whorl is convex but with a tendancy towards flattening of the sides; umbilicus is wholly or nearly closed with a large, heavy callus which spreads along the parietal wall to the upper junction of the lip; the callus at its junction with the lip is very heavy and usually ridged in direction parallel to the rotation of the whorls; the umbilical region is usually not wholly closed, leaving a small cleft at the lower edge of the callus growth open; aperture semilunar, the outer lip thin and sharp, oblique to the vertical axis of the shell; surface smooth, porcellaneous or marked simply by growth lines.

Height 37mm.; diameter 33mm.
33mm.; diameter 30.5mm.

Remarks.— This species is the first of a group of *Polinices* which have continued through the Peruvian Tertiaries to the present time. In the members of this series, the aperture is very large, the spire small, the parietal callus is heavy and the sides of the body-whorl are more or less distinctly flattened. The umbilicus is wholly or partly closed by a heavy deposit of callus.

P. subangulata Nelson, from the Zorritos Miocene is very similar to the Eocene species, and differs mainly in its somewhat lower spire and the last whorl is more strongly flattened. In the recent Peruvian coastal fauna, an analagous species is the *P. alveatus* Troschel, a fairly common shell on the beach at Negritos and neighboring points. Strangely enough, this shell has apparently escaped the attention of most collectors since Tschudi obtained his specimens from an unknown locality along the Peruvian coast. Tryon in his Manual seems inclined to doubt Tschudi's and Troschel's record, and unites *alveatus* with the common West Indian *mammilla* Linné to which it is very close. In *alveatus* the body-whorl is decidedly flattened and the umbilical callus is less heavy and usually leaves the small funicular umbilicus open. The younger shells have the umbilicus more nearly closed, a condition reminiscent of the earlier fossil shells.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Subgenus NEVERITA Risso

Polinices (Neverita) samanensis n. sp. Plate 13, figs. 4, 5

Shell of medium size, low conic with the height somewhat less than the diameter; whorls about 5, the last very large, strongly convex, greatest about the lower half; spire moderately elevated, the individual spire-whorls are slightly convex and separated by distinct close sutures; the base of the shell is somewhat excavated; the umbilicus partly filled with a large callus, which spreads up over the parietal wall, joining in a large, heavy callus with the upper lip; aperture semilunar, with growth lines.

Height 24mm.; diameter 25mm.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Subgenus LUNATIA Gray

Polinices (Lunatia) vicanus n. sp. Plate 13, figs. 7, 8

Shell small, elevated, thin, with a rather high spire and a small open umbilicus; whorls about 5, the last rather large, moderately convex and widest about the middle; the spire-whorls are strongly convex in profile and slowly decreasing in size to form the small and plainly visible nucleus; the spire is elevated and about one-third the height of the full shell; the upper part of each whorl or a band just below the suture is flattened or depressed, producing a scalar-like aspect to the spire profile; umbilicus small, narrow and open; aperture somewhat more than one-half the length of the shell, semilunar, the outer lip simple and oblique; the inner lip or columella is generally slightly thickened or reflected, leaving the small umbilicus freely open; surface smooth.

Diameter 7.75mm.

Remarks.— A small species, resembling somewhat a small *Ampullina* but the plane of the outer lip is oblique to the axis of the shell. From the Restin of Jabonillal.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Subgenus SIGATICUS Meyer and Aldrich

Polinices (Sigaticus) harrisi n. sp. Plate 13, figs. 2, 3

Shell small, with a large body-whorl and a small spire; whorls 5 to 5 1/2, the last very large, convex and widest on the lower half; the spire is short, erect and in size about one-quarter of the height of the rest of the shell; surface is usually white, porcellaneous and marked with fine, revolving lines; these lines are strongest on the zone bordering the upper suture and about the umbilical region, and nearly lacking from a zone about the middle; the umbilicus is nearly closed with a large, thick callus which extends up along the parietal wall to the junction of the outer lip, and at this point, usually carries a small sinus; aperture semilunar, pointed above, rounded below; the outer lip is sharp and in a plane oblique to the axis of the shell.

Height 13mm.; diameter 9.5mm.

Remarks.— The subgenus *Sigaticus* was erected by Meyer and Aldrich[13] with *Sigaretus Bœttgeri* from the Upper Claiborne of Mississippi as type, being the first species described. It differs from the ordinary *Natica* and *Polinices,* by its fine, revolving *Sigaretus*-like spiral lines. Dall considered *Sigaticus,* as a synonym of *Eunaticina* Fischer, but it differs as Harris[14] has maintained by its heavier and typical *Polinices*-like shell. There

[13] Meyer and Aldrich, 1886, Journ. Cinn. Soc. Nat. Hist., vol. 9, p. 42.
[14] Harris, 1899, Bulls. Amer. Pal., vol. 3, No. 11, pt. 2, p. 87.

are several species in the Eocene of the southern United States and it is interesting to find it represented in the contemporaneous rocks of Peru.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Genus AMPULLINA Lamarck

Ampullina ortoni Gabb

Ampullina Ortoni Gabb, 1870, Amer. Journ. Conch., vol. 5, p. 25.
Euspira Ortoni Gabb, 1877, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 8, pl. 35, fig. 3.
Ampullina paytensis Woods, 1922, p. 77, pl. 7, figs. 3, 4.

In 1870, Gabb published a short account of some Tertiary and Quaternary fossils collected separately by Orton and Ramondi at Paita. These collections, on study, were found to contain several recent West Coast species, together with a few new and evidently extinct forms. This association of both living and extinct species led Gabb to believe that the rocks containing them were of Pliocene age, but he also noted that the matrix covering the fossils was different, so that they might have come from rocks of different ages. Field studies, at and near Paita, have shown that Orton's and Raimondi's collections were made from two formations of widely different ages. The recent species and a number of the extinct forms are from the Tablazo limestones of Pleistocene age, while *Ampullina Ortoni* and *Cerithium læviusculum,* both species obtained by Professor Orton, must have been collected from the Upper Eocene Saman sandstones. In the western part of the town of Paita, these two formations lie in juxtaposition, and overlap on the Amotape slates of Pennsylvanian age, which form the coastline to the west of the town.

The typical *A. ortoni,* as figured by Gabb and Woods, is a fairly large species, the mature shell reaching a height of about 60 mm. The upper part of each whorl or along a zone bordering the upper suture is flattened or depressed, but the resulting shoulder of the whorl is rounded. Earlier varieties from the Restin rocks are smaller, the flattening of the upper part of each whorl is stronger and the shoulder of the whorl is more angled.

Lunatia subhumerosa, described by C. A. White[15], from the Provincia de Sergipe and Pernambuco, of eastern Brazil, is probably an *Ampullina,* and its figure resembles quite closely *A. ortoni,* but has a somewhat lower spire and a more inflated body-whorl.

Localities and Geologic Occurrence.— Restin formation, near Negritos, Jabonillal, etc; Saman formation, Lagunitas, Casa Saman (common), Paita (common).

Ampullina gabbi Woods

Ampullina Gabbi Woods, 1922, p. 77, pl. 7, fig. 2a, 2b.

The only specimens, we have of this species are small in comparison to the type shell, described by Woods, and stated as coming from the Negritos formation of Cabo Blanco. At Cabo Blanco, the exposed rocks belong to the upper part of the Pale Gredas and upward through the Cabo Blanco sandstones of Parinas age, into the Restin and Saman. The exact age of the type specimen is therefore not closely fixed.

The specimens in our collection are entirely from the Saman formation. The shells are solid and heavy, and have a general Naticoid appearance. The individual whorls are convex in profile and with deep sutures. The surface of the whorls is faintly to more strongly marked with revolving incised lines. Spire erect.

Localities and Geologic Occurrence.— Cabo Blanco (Woods and Bosworth); Saman formation, Jabonillal, Casa Saman.

Superfamily TÆNIOGLOSSA Bouvier

Family CAPULIDÆ Cuvier

Family CALYPTRÆA Lamark

Subgenus TROCHATELLA Lesson

Calyptræa (Trochatella) aperta Solander

Trochus apertus Sol., 1766, Foss. Hant., p. 9, figs. 1, 2.
Trochus opercularis Sol., idem, fig. 3.
Calyptræa trochiformis Lam., 1802, Ann. du Mus., vol. 1, p. 385, vol. 7, pl. 15, figs. 3a, b, c, d.
Calpytræa trochiformis Deshayes 1824, Coq. Foss. Env. Par., vol. 2, p. 30, pl. 4, figs. 1, 2, 3.
Calyptræa trochiformis Dall, 1892, Trans. Wagner Free Inst., vol. 3, pt. 2, p. 352.

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[15] White, C. A., 1888, Contr. Pal. Brazil, Archivos do Museu Nacional do Rio de Janeiro, vol. 7, p. 183, pl. 16, figs. 5, 6 and 7.

Calyptræa trochiformis Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 103.
Calptræa aperta Harris, 1897, Bulls. Amer. Pal., vol. 2, No. 11, p. 84, pl. 11, figs. 13-16.
Calyptræa aperta Cossmann and Pissarro 1910-1913, Icon. des coq. fos. de l'Eocene de Paris, pl. 12, fig. 73-1.

Natural to the sedentary habits, the shells of the species of *Calyptræa,* and allied genera are extremely variable in form and the discrimination between similarly sculptured species is very difficult. Species of very similar aspect occur in the Tertiary and recent faunas in most parts of the world and it is a question whether these shells should be considered as strictly conspecific. The reference of the Peruvian fossils to the Parisian *C. aperta* Solander (*C. trochiformis* Larmack), is therefore made with certain hesitation. *C. aperta* has been recorded from the Wilcox and Clabornian Eocene of the southern United States, the Claiborne shell having been described by Conrad as *C. urticosum.* Dall gives the range of *C. trochiformis* as extending from the Eocene, through the Vicksburg Oligocene and into the Miocene.

C. (*rochatella*) *ornata* Bast. from the Aquitanien Miocene of France, is also very similar to the Peruvian shells. The excellent figures of Cossmann and Peyrot[16] show a shell somewhat larger than the Peruvian, but very similar in sculpture and other features.

The Peruvian shells have generally a low spire, close sutures, rapidly diminishing whorls and a wide, nearly circular, excavated base. In the higher spired varieties, the whorls are more convex, the sutures deeper and the whorls diminish more slowly in size. The under surface of the shell is smooth, with a straight lip such as characterizes the Subgenus *Trochatella* Lesson.

Localities and Geologic Occurrences.— Parinas formation, Keswick Hills; Restin formation, Jabonillal.

Calyptræa saxosa n. sp. Plate 13, figs. 11, 12

Shell irregular, *Crepidula*-like, but with rapidly enlarging whorls, deep sutures and an erect, pointed nucleus; general form as best shown by the figures is elongate, so that a cross-section of the base is broadly elliptical; whorls 2, 3, or more, the lower inflated and large but rapidly diminishing to a very small size on the spire; spire small, erect, pointed and situated a short distance back of the center; surface generally smooth but sometimes obscurely furrowed or folded in a spiral direction; internal characters not exposed.

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[16] Cossmann and Peyrot, 1909-1912, Conchologie Neogenique de l'Aquitaine, p. 483, pl. 13, figs. 32-33, pl. 14, fig. 1

Length 30mm.; height 17mm.; diameter 20mm.

Remarks.— From *C. aperta,* this species differs by its smooth surface and more erect and higher shell and spire. Some broken specimens have much the appearance of a *Crepidula,* except that they have a definite spire and true whorls.

Locality and Geologic Occurrence.—Saman formation, Casa Saman.

Family TURRITELLIDÆ Gray

Genus TURRITELLA Lamarck

Turritella hopkinsi n. sp. Plate 14, fig. 2

Shell very long and slender, with slowly tapering, flat whorls and strong spiral sculpture; whorls very numerous, flat or slightly concave or constricted in a zone, approximately situated at the lower edge of the upper one third of each spire-whorl; the upper suture is bordered below by an appressed belt, often resembling a broad cord and generally over-run by fine spirals; below this appressed band, the surface of the whorl is sculptured with about 6, sharp, spiral threads or ridges, which steadily increase in size towards the lower suture; the three lower spiral threads or ridges are quite strong, the lowest situated in or just above the lower suture; the growth-lines are sinuous as typical of the genus, with a shallow, wide, sinus, the apex of which is directed backwards and lies in the zone just below the upper sutural cord.

Length 32mm.; diameter 14.5mm.

The *T. hopkinsi,* is a species of the Salina formation, to which it is probably restricted. It is usually quite common, but always in a fragmentary condition, and the features of its earlier whorls and the base, are not sufficiently well known for close characterization. From *T. bosworthi* Woods, with which the species occurs, it differs in its slow, gradual taper, and the full-grown, perfect shell must have been extremely long and slender. The strong keel of *T. bosworthi* is lacking on the present shell and in addition the strong cord-like band about the upper suture will help in its recognition.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Turritella iddingsi n. sp. Plate 14, fig. 1

Shell very long and slender, with slowly tapering whorls and a strong sutural cord, along the upper edge of each whorl; whorls very numerous, flat, except for a strong cord closely bordering the upper suture; below the sutural cord, there are 8 or 9, irregular spiral threads, and a fairly wide, concave zone, just above the lower suture; growth-lines are heavy and raised, straight and parallel to the axis of the shell on the lower part of each spire-whorl, but developing a wide, shallow sinus at the upper third; as the growth-lines cross the upper sutural cord, they become more crowded, strongly oblique and give a rope-like appearance to the sutural cord; fine spiral lines cover most of the surface of the shell, and with the aid of the growth lines, develop a trellised-like finer sculpture.

Length 40mm.; diameter 13mm.

Remarks.— Of the Peruvian Turritellas, this species resembles *T. hopkinsi,* most closely, both species having very numerous whorls and a straight and very slender shell. In *T. hopkinsi* the sutural cord is generally weak or simply a wide appressed band, while in *T. iddingsi,* this structure is typically cord-like and sculptured in a rope-like fashion, by the heavy and strongly oblique growth-lines. The spirals on the rest of the shell, are more numerous and of irregular distribution.

The *T. iddingsi* and *restinensis,* are guide fossils for the Restin formation. As in the case of *T. hopkinsi,* the long and slender shell is not adapted for perfect preservation and usually only fragments of 2 or 3 whorls can be collected.

Locality and Geologic Occurrence.— Restin formation, Negritos, Jabonillal, Restin, etc.

Turritella samanensis n. sp. Plate 14, figs. 3, 4, 6, 7, 8

Shell small or medium size, and when full-grown with whorls closely sculptured with fine, spiral threads; individual spire-whorls gently convex to nearly flat, with deep or close sutures; on the earlier spire-whorls, the sculpture usually consists of about 3, heavy spirals on the center of the whorl, bordered above by three, finer spirals, and below by one or more fine spirals; on the later whorls, the sculpture tends to be subregular with the major spirals numbering 10 or more; the interspaces between the major spirals, generally have a fine spiral thread, together with still finer or submicroscopic spirals; growth-lines not conspicuous, the sinus relatively shallow.

Length 34mm.; diameter 10mm.

From the associated species, *T. samanensis* is distinguished by its gentle, evenly convex whorls and nearly regular sculpture of the later whorls. On young shells the sculpture is heavier and they differ from the young of *T. chira,* in having 3 instead of 2 major spirals, and the whorls are convex and not subangular in profile. The taper of the shell is also more gradual.

T. uvasana Conrad from the Tejon Eocene of California, is quite similar to *samanensis,* but evidently is a larger and coarser species. In the later Tertiaries, the type or group to which *samanensis* belongs, is abundantly represented by numerous species and includes such species as the *T. prenuncia* Spieker of the Zorritos Miocene.

Localities and Geologic Occurrence.— Saman formation, common throughout; Oligocene records to be given later.

Turritella chira n. sp. Plate 14, fig. 5

Shell larger than *T. samanensis,* heavy and with subangular, closely sculptured whorls; the form of the shell is moderately short and stubby with a rapid taper; individual spire-whorls strongly convex or subangular, widest about the lower third; the sculpture consists of about 2 heavy, sharp spirals on the angular portion of the lower third, with the slope above bearing 6 or more finer spirals and still finer intercalated spiral threads; below the 2 heavy, primary spirals, the sutural area is deeply concave and usually smooth; on the early whorls, the sculpture tends to be more regular and with a less number of spirals; characters of the base not shown.

Length 34mm.; diameter 13mm.

Remarks.— The above description applies to the typical form of this species, in which the whorls are strongly subangular in profile and with 2 major, sharp, keel-like spirals. Varietal forms may have the whorls more smoothly convex, and the two major spirals are less strong. The distinguishing characters between this species and *samanensis,* with which it occurs at most stations have been noted in the discussion of that species.

Localities and Geologic Occurrence.— Saman formation, throughout, also abundant in the Peruvian Oligocene.

Turritella boughtoni n. sp. Plate 14, figs. 9, 10

Shell of medium size, with straight flat whorls, slightly overhanging the lower sutures; taper of the shell is at first very gradual, but becomes more rapid on the later whorls; the individual whorls are flat, but the later ones of the full-grown shell, slightly overhang the lower sutures, due to the development of a heavy sutural cord; on the early whorls of the spire, the sculpture consists of two major spirals adjacent to the lower suture and with 4 fine spirals on the portion of the whorl above; on the later whorls, the lower of the major spirals increases more rapidly in size, than the others and eventually developes into a heavy, striated sutural or peripheral cord; the upper of the two major spirals remains small or becomes double in size, and about equal to the spirals above; all the spirals, except the peripheral cord are typically, finely beaded; the peripheral cord is heavily striated with spiral lines; base of last whorl is flattish or slightly convex and with 4 or 5 fine spirals.

Length 45mm.; diameter 13.5mm.

Remarks.— This species is well characterized by its straight whorls, heavy peripheral and sutural cord and fine beading of its upper spirals.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Turritella keswickensis n. sp. Plate 14, figs. 11, 13

Shell small with nearly straight whorls and strong spiral sculpture; sutures distinct and generally lying near the lower side of a deep sutural zone; on the early whorls, the spiral sculpture consists of 3 or 4 cords, slightly heavier below; additional spirals appear on the later whorls, the primary cords increasing to 6 or more, with smaller secondaries in between; fine secondaries cover the whole shell including the sutural zone; the spirals appear faintly beaded; base broken or encrusted with rock.

Length 23mm.; diameter 8mm.

Remarks.— This is a small species quite common in the Parinas sandstones. It is possibly the forerunner of *Turritella boughtoni* or of the series which finally led to the development of the *Turritella altilira* stock in the Miocene. The whorls are typically flat with the spirals finely beaded.

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Family CERITHIIDÆ Menke

Genus CERITHIUM Brug. sensu lato

Cerithium hopkinsi n. sp. Plate 16, fig. 1

Shell large, heavy and rather slender or elongate; whorls 6 or more, strongly shouldered on the upper fourth; above the shoulder and between it and the suture, the surface of the whorl is contracted or irregularly flattened or undulated; the sutures are close and somewhat appressed; below the shoulder, the whorl is nearly flat or very slightly convex, and the surface faintly undulated, as if to form, low and subobsolete ribs; on the lower half of the later spire-whorl, there are 3 or more, widely spaced spiral cords or ridges, the lowest and heaviest, covered by the close sutures and only appearing on the base of the last whorl; the inner lip or columellar area appear to have been strongly thickened; outer lip broken.

Length 134mm.; diameter 47mm.

Remarks.— This is a large, heavy shell with strongly angled or shouldered whorls. The surface appears to have been generally smooth with subobsolete rib-like waves and the lower half of the last whorl with strong, cord-like spirals.

Locality and Geologic Occurrence.— Restin formation, Que. Botija.

Cerithium iddingsi n. sp. Plate 15, fig. 4

Shell large, heavy and very slender; whorls were probably very numerous, but only three are preserved on the type specimen; they are slightly convex in profile with close and more or less appressed sutures; the earliest whorl preserved, has about 8, moderately heavy, knob-like ribs, sometimes with lower and subobsolete curved ribs in between; the ribs are bordered above by a deeper, concave sutural area, which is striated with 5 or 6 spiral threads; on the two following whorls, the knob-like character of the earlier ribs have disappeared and the surface is sculptured with numerous curved riblets which number about 24 on the last whorl; they are subobsolete in character on the surface of the whorl adjacent to the upper suture; the ribs continue across the base of the shell to the columellar region; the upper sutural areas is striated with 5 or 6 spiral lines, as found on the earlier whorls and 4 or 5 heavy, spiral cords encircle the base of the shell; growth lines curved and following the general trend of the sculpture; apertural and columellar characters not preserved.

Length 91mm.; diameter 44mm.

Remarks.— The type of this interesting species is a fragmentary specimen of about 3 whorls. When perfect, the shell was probably quite slender, and the earlier whorls sculptured with more or less knob-like ribs, which become on the later whorls, more numerous, strongly curved and ripple-like. The aperture and columellar portion of the shell is unfortunately not preserved so that the relationship of the species must remain in doubt until better specimens are discovered.

Locality and Geologic Occurrence.— Pale Greda formation, two miles east of Negritos.

Cerithium boweni n. sp. Plate 15, fig. 1

Shell large, heavy, subelongate; whorls straight, coronated above with a rather heavy, wide ridge; which is strongly excavated above by a deep sutural groove; longitudinal sculpture consists of about 14, faint ribs, strongest on the middle of the whorl but fading out both above and below; the upper edge of each whorl carries a wide band or ridge, and below this structure about 5 heavy, spiral ridges separated by deep, wide grooves; on the center of the whorl surface, these spiral ridges are undulated by the longitudinal ribs; 3 or more additional but plain spiral ridges encircle the base of the last whorl; aperture and columella not preserved.

Length 75mm.; diameter 53mm.; fragmentary specimen.

Remarks.— The two specimens in our collection are fragmentary and show only two whorls, but the sculpture is so characteristic that no difficulty will be had in the future identification of the species. The longitudinal ribs are somewhat variable in size and apparently increase in number on older shells.

Locality and Geologic Occurrence.— Pale Greda formation, Restin.

Cerithium xenium n. sp. **Plate 16, fig. 6**

Shell large, heavy and very slender; whorls numerous, the earlier ones nearly flat, but the later ones becoming strongly angled about the middle and the surface of the whorl above, more or less strongly concave, or sloping towards the upper sutures; sutures close, sometimes impressed; the surface is smooth, except for the slightly, bowed or curved growth-lines; the base of the lower whorl has a slight indication of an encircling ridge, above which there is sometimes to be seen, faint spirals or ridges; aperture broken.

Length 80mm.; diameter 31.5mm.; 5 whorls

Remarks.— A very slender, smooth species, the later whorls developing a shoulder and a concave sutural area, such as found amongst the *Turridæ.* It is a species of the Restin formation.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Genus TELESCOPIUM Montfort

Telescopium parinense n. sp. **Plate 17, fig. 4**

Shell Turritelloid, with straight sides and a rapid taper; whorls 8+, with very close, indistinct sutures; sculpture consists of a wide, but not prominent cord bordering the upper suture and below this with 6 additional but narrower spiral ridges; the periphery of the last whorl is angled or keeled and carries the lowest of the 6 spirals described above, and which on the spire-whorls lies just above the lower suture; below the periphery, the base of the last whorl has a wide groove, edged anteriorly by a double spiral, but leaving the rest of the base smooth; growth lines strongly sinuous and recalling those of *Glauconia;* there is a wide and moderately deep sinus like that of *Turritella,* on the upper surface of the whorl, and another deep sinus is found on the base, midway between the periphery of the whorl and the columella; inner lip somewhat calloused above, but broken below on our specimens so that the presence or absence of a columella plication cannot be established.

Length 39mm.; diameter 19mm.; (type)
27mm.; diameter 20.5mm.; (1 1-2 whorls)

Remarks.— In form and general features, this species resembles very closely the *Telescopium fuscum* Chemnitz, a recent species inhabiting the salt marshes at the mouth of certain East Indian rivers, and the type of the genus *Telescopium.*

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Telescopium? samanense n. sp. Plate 15, figs. 2, 3

Shell large, heavy, subelongate; whorls 6 plus, generally flat-sided with straight, close sutures and each spire-whorl averaging in height about one-third their width; the periphery of the last whorl is angular and with the base strongly flattened and lying in a plane almost at right angles to the longitudinal axis of the shell; longitudinal sculpture consists of about 10 straight ribs with very wide, shallow but concave interspaces; these ribs generally pass from suture to suture, sometimes in line with each other across the spire-whorls, or more or less off-set; the periphery of the last whorl is angular and carries two spiral ridges, below which the longitudinal ribs do not pass; the flattened base is smooth; columella apparently a little twisted, smooth and without any columellar plication; lip broken.

Length 68mm.; diameter 33mm.

Remarks.— This species and an allied form, described by Woods from Lagunitas as *Telescopium peruvianum,* form a group of species very characteristic of the Peruvian Upper Eocene rocks. They evidently belong to the *Potamidinæ,* although always clearly associated with a truly marine fauna. They differ from typical *Telescopium* by their heavier shell and strong longitudinal sculpture, but until specimens are obtained with the aperture more perfectly preserved, their true relationship cannot be determined.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Family STROMBIDÆ Swainson

Genus ECTINOCHILUS Cossmann

Ectinochilus gaudichaudi d'Orbigny, 1842, Plate 16, figs. 3, 4, 5, 7

Rostellaria gaudichaudi d'Orbigny, 1842, Voyage dans l'Amerique meridionale, Paleontologie, p. 116, pl. 14, figs. 6, 7, 8.

Dientomochilus (*Ectinochilus*) sp. cf. *laqueata* (Conrad) Woods, 1922, p. 92, pl. 12, figs. 3a, 3b.

E. gaudichaudi, was the first fossil described from the true Tertiary rocks of northern Peru. It was originally collected by Orbigny, during his visit to Paita, together with several Pleistocene shells, obtained from the tablazo rocks, exposed in the high sea-cliffs to the east of the town. He described the original specimen as an imprint in a "friable, greenish-yellow Tertiary rock". The origin of this specimen is clearly from the outcrop of the Paita Saman sandstones or in a boulder from the same source.

Woods compared his specimens from the upper Saman sandstones of Casa Saman (10 miles W. N. W. of Sullana), with *D.* (*E*) *laqueata* Conrad[17] from the Claibornian of Alabama. In typical *laqueata,* the anterior canal is strongly curved upwards and backwards, the siphonal fasciole is large, but more confined so that the anterior extremity is only obliquely truncated. The sculpture consists of fine, longitudinal ribs or waves, which occur in a subobsolete manner over most of the surface, but usually lacking in the larger specimens from the ventral side of the last whorl. The posterior canal has more limited developement, it may extend to the tip of the spire in young shells, but in mature forms it is usually continued only about one-half the whorl width, above the upper suture of the penultimate whorl.

E. gaudichaudi, is typically a rather slender species, with nearly smooth whorls, the anterior siphonal sinus is wide; the posterior canal is strongly developed, extending clear to the tip of the spire and often continues down the other side as in the type species, *E. canalis* Lamarck.

Typical *E. gaudichaudi,* is probably confined to the Upper Saman, and reaches a total length of nearly 30 mm. A smaller and more strongly sculptured form, probably a variety of *gaudichaudi* occurs in the basal Saman, or in the horizon of the Saman conglomerate. It differs from true *gaudichaudi,* in its smaller size (length 21 mm.), the spire-whorls are sculptured with fairly strong ribs, which appear continued across the sutures of the earlier whorls, but lacking from the last or body-whorl. The last whorl is often impressed in a *Strombina*-like manner on the right side, and the canal and the lower part of the whorl is strongly sculptured with even spirals . The posterior canal is strongly developed, extending to the apex of the spire and down the opposite side. To distinguish this form, from typical *gaudichaudi,* the varietal name of *alauda* is here proposed.

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[17] Conrad 1833, Foss. Shells Tert. Formations, p. 41, pl. 15, fig. 4.

Length 27mm.; diameter 11mm.; typical *gaudichaudi*
21mm.; diameter 9mm.; variety *alauda*

Localities and Geologic Occurrence.— Saman formation, Casa Saman and Paita (*gaudichaudi*), the horizon of the Saman conglomerate at Negritos (var. *alauda.*).

Genus CALYTRAPHORUS Conrad

Subgenus AULACODISCUS H. Douvillé

Calytraphorus (Aulacodiscus) lissoni H. Douvillé, Plate 18, figs. 1, 4

Aulacodiscus lissoni H. Douville, 1921, Compte Rendu somm. Soc. geol. France, No. 14, p. 193, 194, figs. 1-3.

This very singular fossil was described by H. Douvillé from specimens sent to him from Señor M. Lisson of Lima, as a new subgenus of *Calyptraphorus* Conrad. The mature *Aulacodiscus lissoni,* has a subcircular or pebble-like form, the spire wholly covered by a heavy callus and the anterior end is short and in most specimens broken away. The posterior canal is continued as a complete and nearly circular groove near the edge of the ventral face. In younger shells, the callus is less completely developed and the spire and anterior canal are fairly long. These young shells show clearly the relationship of *Aulacodiscus,* with *Calyptraphorus* as suspected by Douvillé.

Aulacodiscus is probably related to *Veatchia carolinea* Maury from the Midway or Lower Eocene of Soldado Rock and Trinidad, but the two known specimens of *V. carolinea,* are imperfect and close comparison is not possible. *Veatchia carolinea* is a larger shell and the posterior canal shows a wide sinus on the right ventral side.

Aulacodosis lissoni, is a very common and characteristic species in the Negritos formation both at Negritos and La Brea. It does not occur in the higher rocks.

Length 32mm.; diameter 27mm.

Localities and Geologic Occurrence.— Negritos formation, Negritos, La Brea.

Family CYPRÆIDÆ Gray

Genus CYPRÆA Linné

Subgenus MONETARIA Troschel

Cypræa boggsi n. sp. Plate 16, fig. 2

Shell of medium size, solid and heavy; base is strongly flattened with a relatively narrow aperture and a large, heavy outer lip; dorsal surface is moderately but not strongly convex with a well-defined or impressed margin or collar, above which the back or center of the shell, rises in a convex, hump-like manner; such as seen in the members of the Subgenus *Monetaria;* the flattened base with four or five, transverse folds or plicæ, on the anterior and posterior extremity, with shorter plicæ in between.

Length 36mm.; height or thickness 16.5mm.; breadth 26mm.

Remarks.— The strongly flattened base, wide outer lip and specially the form of the dorsal surface, suggests that this species is a member of the Subgenus *Monetaria* Troschel of which *C. moneta* Linné, the recent money Cowry is the type species.

The outer lip and the dorsal surface are badly weathered on the single specimen known, so it cannot be determined to which section of *Monetaria,* the species should be referred.

Locality and Geologic Occurence.— Saman formation, horizon of Saman conglomerate, near Lagunitas.

Family OVULIDÆ Fleming

Genus OVULA Bruguieré

Ovula negritensis n. sp. Plate 20, fig. 3

Shell subglobular and in general form similar to the *Ovula ovum* Linné, but probably shorter and more ventricos when perfect; outer lip (broken) projects considerably above the summit of the shell, with the aperture moderately wide and of even width throughout; spire entirely concealed; inner lip and columellar area smooth or feebly marked by transverse growth lines.

Height 37mm.; diameter 25mm.

Remarks.— A single imperfect specimen of this interesting shell has been collected from the Saman conglomerate near Negritos. The outer lip is broken and it is therefore not known whether the lip was crenulated internally as typical of *Ovula* s. s. or smooth as in the Subgenus *Simnia* Leach. The outer lip appears to have been somewhat thickened, projecting above the apex of the shell, and joined with the body-whorl in a heavy, callus-like thickening covering the summit. The inner lip or parietal side of the body-whorl is smooth.

Locality and Geologic Occurrence.— Saman formation, horizon of Saman conglomerate near Negritos.

Family CASSIDIDÆ Adams

Genus CASSIDEA Bruguière

Cassidea maccormacki n. sp. Plate 17, figs. 5, 6

Shell small, solid, with a short spire and a large body-whorl; whorls 4 plus (the earlier spire-whorls lacking from our specimen), those of the spire, convex about the middle and strongly sculptured with vertical ribs numbering about 10 to each volution; the body-whorl is very large and more than twice as long as the height of the spire, strongly but narrowly shouldered, below which the sides of the whorl are straight; the shoulder of the last whorl is armed with transverse folds or ribs, which extend about half way down the sides; there is a finer sculpture of even, coarse, spiral threads, closely spaced or separated simply by deep lines; aperture narrow, the outer lip provided with a heavy varical rib, crenulated within; a large spreading callus is formed on the body-whorl in a typical *Cassis*-like manner, through which the ribs are continued as short, subobsolete folds; a broad shallow sinus is present at the upper edge of the aperture.

Height 26.5mm.; diameter 18mm.; (type)
32mm.; diameter 21mm.

Remarks.— The anterior canal is broken or worn in all our specimens so that the characters of the siphonal canal is not shown. In *Cassis* proper, which this species resembles in most particulars, the canal is short and strongly recurved. The parietal callus is large and spreading, completely covering or concealing the ventral side of the body-whorl. In form and size, the shell resembles *Morum* Bolten (*Oniscia* Sby), of which we have a species from the Chira shales, but differs in its more *Cassis*-like apertural callus.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate, near Lagunitas.

Genus SCONSIA Gray

Sconsia? samanica n. sp. Plate 17, figs. 9, 10

Shell subovate, stout, with a moderate spire, slightly more than one-third the length of the aperture; whorls about 6, the first two belonging to the small but prominent smooth nucleus; the first one-quarter of the first post-nuclear whorl is sculptured with smooth, heavy ribs, but spirals are soon introduced and the transverse ribbing gradually fades until it is nearly absent from the last two whorls; sutures deep, bordered anteriorly by an evident but subobsolete band, formed by the raised edge of the next whorl; the last whorl is large, convex, slightly impressed above so that the profile appears feebly shouldered; the surface is nearly smooth about the middle, or faintly striated, but with heavy or subobsolete spiral threads or cords on the anterior canal and the sutural areas; anterior canal long, curved, with an elliptical aperture, pointed and with a feeble canal at its posterior end; the outer lip is moderately thickened; internal characters of the lip and columellar area not visible in our specimens.

Length 28.5mm.; diameter 18mm.

Remarks.— This fossil is provisionally referred to *Sconsia* because of its resemblance to young shells of the Caribbean Miocene *Sconsia lævigata* Sby. All our specimens have the tip of the anterior canal broken and the aperture completely filled with rock, so the features of these parts is not known.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Family DOLIIDÆ Adams

Genus PYRULA Lamarck

Pyrula otaria n. sp. Plate 17, fig. 3

Shell small, thin, pyriform; spire moderately high of about 6 whorls, the first belonging to the small, smooth nucleus; subsequent spire-whorls are slightly convex, between close, indistinct sutures; the body-whorl is large, evenly convex and passing below or anteriorly into a long canal; sculpture is rather coarsely reticulate or the usual *Pyrula* type of nearly regular, transverse and spiral threads; on the earlier spire-whorls, there are about 4 spiral threads increasing to 7 or more on the later; anterior canal long and slightly curved.

Height 20mm. (fragmentary); diameter 15mm.

The spire in this species is longer than usual in the majority of species of this genus.

Locality and Geologic Occurrence.— Saman formation, horizon of Saman conglomerate, near Negritos.

Superfamily RACHIGLOSSA Gray

Family BUCCINIDÆ Troschel

Genus PSEUDOLIVA Swainson

Pseudoliva parinasensis Woods

Pseudoliva parinasensis Woods, 1922, p. 93, pl. 12, figs. 4-6.

Wood's original specimens came form the Parinas sandstones and his figures are quite typical and illustrate the form and size (about 30 mm.) of the species as it occurs in the Parinas and older beds. The spire is short, acute and erect, partially envolved by the encroaching of the body-whorl and the spiral sculpture is fairly evident over the whole shell. Their full maturity is shown by the great width of the sutural band, lacking or but poorly developed on young shells.

P. vetusta Conrad, ranging through the Midway, Wilcox, Claiborne and Jackson Eocene of the southern United States closely resembles *parinasensis,* but the whorls are more strongly shouldered and its developement is different from the Peruvian. In the earlier beds, the base is simple and imperforate, but in the Upper Eocene or Jacksonian, a very wide umbilicus is developed. It would appear therefore that *vetusta* belongs to a different stock.

Locality and Geologic Occurrence.— Very rare and small in the Negritos formation at Negritos; somewhat more common and larger in the Salina formation at Negritos; fairly common in the Parinas formation near Negritos, Keswick Hills etc.

Pseudoliva parinasensis var. **samanica** n. var. Plate 19, figs. 1, 3

In the higher rocks beginning in the Saman and continuing through into the Upper Oligocene, *Pseudoliva* becomes quite common and uniformly of large size. It is evident that these shells represent the continued evolution or development of the *P. parinasensis* stock first begun in the Negritos and Salina formations. Our collection contains a very full series from the Saman Eocene and Oligocene formations.

Young specimens from the Upper Eocene and Oligocene are very similar and seldom can be consistently distinguished from each other. The spire is well-formed, moderately high and acute. The surface is smooth or with only faint spirals and the immaturity of the shell is shown in the slight development of a sutural zone and in the slight callus growth along the upper part of the inner lip. From shells of the same size from the Parinas, the general form is less rotund, and the anterior portion is uniformly narrower.

With maturity, the shells become large, the average size being about 45mm. but larger individuals reach a height of 55 to to 60mm. The callus becomes very large and heavy, spreading upwards so that the last whorl encroaches to a greater or less degree over the earlier spire whorls. In the Oligocene forms, the callus appears earlier than among the Saman shells, and remains continually larger. The form of the mature Oligocene Pseudolivas is therefore broader and stronger shouldered. Since these forms have a truly stratigraphic significance, they are here given separate varietal names.

In the variety *samanica* of the Saman or Upper Eocene, the last whorl is large, inflated and the spire is short, partially concealed by the large enveloping body-whorl. The form of the shell is ovoid, there is no shoulder, and the callus is large, extending as a large mass, above the posterior canal. Surface smooth. In form the shell is quite similar to typical *parinasensis,* but the spire is generally shorter, the body-whorl is proportionately larger, a heavier callus and smoother whorls.

Localities and Geologic Occurrence.— Saman formation, throughout and particularly common in the Saman sandstones of the Chira valley, Paita, and at Bayovar.

Pseudoliva parinasensis var. mancorensis n. var. Plate 19, figs. 4, 6

In the Oligocene forms, the mature shells are consistently shorter and more stubby, as illustrated by the figured specimens. The last whorl is strongly shouldered and the shell is distinctly flattened above with a short protruding spire. This variety is the dominating form in the Oligocene strata and occurs in the Chira, Mancora and Heath formations. The average size is about 45mm.

Localities and Geologic Occurrence.— Chira formation, Several localities in the Chira valley, the Sal Chica beds of Punta Sal, Que. Seca, etc: Mancora formation, throughout the Chira valley, Que. Charanal, Lagunitas, the Punta Bravo beds of Punta Sal—Punta Mero, Mancora sandstones near Mancora, etc. Heath formation, the Cone Hill shales of the Chira valley, the Caleto Mero shales of Caleto Mero, etc.

Pseudoliva monilis n. sp. Plate 18, fig. 10

Shell small, oliviform or broad elliptical; body-whorl large and inflated; spire produced, of about 4 whorls, pointed and acute; sutures close, and covered by a narrow, appressed band, with the growth lines directed towards the aperture; the body-whorl is generally smooth above, except for a prominent, crenate or regularly toothed band, which emerges from the suture and encircles the whorl, meeting the outer lip about a third of the distance down from its upper junction; the outer lip provided at the lower one-third with a small tooth which produces a revolving groove as usual with species of *Pseudoliva;* below this groove the surface is marked with 14 or 15, regular, incised, spiral lines; the anterior end of the shell is deeply grooved by the siphonal notch; outer and inner lip free from callus.

Height 18mm.; diameter 10.5mm.

Remarks.— Among our specimens from the Parinas sandstones of Keswick Hills, there is little variation in the size and strength of the crenate band, varying from rather coarse to quite fine. In the Restin of Jabonillal, a varietal form is present, differing from the typical Parinas form, in being somewhat broader and the crenate band is always much finer and thread-like. When perfectly full-grown, this form is quite similar to *P. parinasensis* but the spire is somewhat higher and the fine crenate band is still evident.

Localities and Geologic Occurrence.— Parinas formation, Keswick Restin formation, Jabonillal.

Pseudoliva modesta n. sp. Plate 18, fig. 7

Shell small, thin and in form recalling certain species of *Oliva* of the section *Hiatula;* the body-whorl is large and two-thirds the length of the whole shell; the spire is high, acute and formed of 5 or 6 whorls; the individual spire-whorls are slightly convex and with close, appressed sutures; the body-whorl is encircled about the middle with a strong *Pseudoliva* groove, above which the shell is smooth except for growth lines, and a very faint row of small but distantly spaced nodules such as found on *P. monilis;* below the spiral groove, the shell is strongly sculptured with lines, producing 16 to 17 fairly wide spiral bands; siphonal notch moderately deep.

Height 26mm.; diameter 11mm.

Differs from the preceding species in being thinner, more slender and more typical Oliviform, but obviously belonging to the same group. The carinate band so well developed on *P. monilis* is nearly lacking from the present species but on close examination a few faint and distantly spaced teeth will be seen.

Locality and Geologic Occurrence.— Saman formation, Saman conglomerate, near Negritos.

Pseudoliva mutabilis Woods

Pseudoliva mutabilis Woods, 1922, p. 94, pl. 12, figs. 7-11.

Under this general name, Woods included a group of curious and highly specialized shells, beginning in the Negritos formation continuing through the Salina and Parinas into the Restin. Similar to the group of *P. parinasensis,* a progressive evolution may be followed as the species ascends from the lower to the higher rocks.

Woods's description is based on specimens from the *Turritella* series (Negritos formation), and his figures 7 and 8, represent the typical form and to which the name of *mutabilis* strictly belongs. It is a rare shell and we have no good specimens in our collection. The spire is relatively high, strongly shouldered with very few shoulder tubercles and a callus simply lines the suture of the last whorl. It may be compared with the *P. scalina* Heilprin of the Wilcox of the southern United States, and to the *Harpa dechordata* White from the Maria Farinha beds of eastern Brazil, but this later species seems to be umbilicate.

Locality and Geologic Occurrence.— Negritos formation, Negritos.

Pseudoliva mutabilis var. **woodsi** n. var. Plate 20, fig. 5

In the Salina formation, and often quite plentiful at the very base of this formation, the shells belong to the form illustrated by Woods's figure 9. The spire is lower, less scalar, the suture deeply canaliculate and the shoulder of the whorl is continuously provided with heavy, but not spine-like ribs or tubercles. The early spire-whorls are ribbed and on the last whorl, the tubercles number about 13. At maturity and to a less extent at earlier resting periods, a heavy callus is formed which spreads a short distance back over the surface of the preceding whorl, covering to a certain extent the finer sculpture; the surface of the whorl is rather strongly sculptured with spiral lines.

Locality and Geologic Occurrence.— Salina formation, Negritos.

Pseudoliva mutabilis var. **douvilléi** n. var. Plate 20, fig. 1

The specimens illustrated by Woods's figures 10 and 11, are stated as being from the Parinas sandstones. I have seen no specimens from the Parinas formation, and I strongly suspect that Woods's specimens were obtained from the basal Restin. At many localities in the Negritos region, the basal Restin is very fossiliferous and unless care is taken in the differentiation between the Restin and Parinas rocks, their fossils may easily become mixed or confused with those of the Parinas. Lithologically the basal Restin may be recognized by its yellow or orange color and rapidly intergrading with the overlying shales.

The variety *douvillei* is the final and most highly specialized member of the *mutabilis* stock. The shell is large, heavy and coarse. The shoulder is sharp and in all of our specimens carries large, coarse, spine-like knobs or tubercles. The callus is very large and heavy, and covering completely most of the surface of the spire whorls, and simulating a broad band or turban. The suture remains deeply canaliculate and the spiral sculpture is obsolete.

Woods's figure 10, is similar to our shells, except that the shoulder of the whorl is simply, sharply angled. In *woodsi,* the callus is formed only at maturity or during brief resting periods, while in the senile and gerontic *douvillei,* the callus is continually formed, except in the very earliest stages.

Locality and Geologic Occurrence.— Restin formation, Negritos.

Genus TRITONIDEA Swainson

Tritonidea staufti n. sp. Plate 17, fig. 11

Shell of medium size, buccinoid with an elevated, acute spire and a moderately long, anterior canal; whorls about 6 (plus with the broken nucleus), the spire-whorls slightly convex in profile and sculptured with wave-like ribs and moderately heavy, subregular spiral threads; body-whorl large, inflated, strongly convex about the center, and contracted about the base into the moderately long anterior canal; sutures distinct, often bordered anteriorly by a cord or the elevated edge of the whorl; sculpture of last whorl similar to the preceding but with the ribs more wave-like and developed only on the upper half of the whorl; the spirals are strong, subregular and with wide interspaces; aperture large, broadly subelliptical, the outer lip apparently thickened but its internal characters concealed.

Height 28mm.; diameter 17mm.

Remarks.— In form and general texture, this shell resembles certain species of *Cominella,* rather than those of *Tritonidea.* The anterior canal is moderatetly long and there is no keel or encircling ridge above the trace of the siphonal sinus. Our specimens are all incomplete, usually with the anterior canal broken or imbedded in rock.

Locality and Geologic Occurrence.— Saman formation, Casa Saman.

Genus ALECTRION Montfort

Alectrion salina n. sp. Plate 18, fig. 13

Shell small, elevated with 4 smooth nuclear and 4 subsequent whorls; the nuclear whorls pass insensibly into the post-nuclear, the transverse sculpture beginning within one-fourth of a turn as fine, raised threads with wide intervals, faintly marked with 4 or 5 incised spiral lines; the transverse sculpture consists on the last whorl of 9 to 11, strong, rounded ribs which begin on the canal and continue straight to the suture; on the post-nuclear whorls of the spire, the transverse ribs are strong and straight from suture to suture; the spiral sculpture consists on the spire-whorl of 6 to 9 threads which faintly nodulate the rounded summit of the ribs; on the last whorl there are 19 spiral threads; outer lip not thickened; anterior canal slightly twisted, with a strong siphonal notch.

Length 12.5mm.; diameter 6mm.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Alectrion terebratula n. sp. Plate 18, figs. 14, 15

Shell small, elevated, with 4 nuclear and 3 subsequent whorls; the nuclear whorls are smooth except on the last one-half turn which is marked with fine, raised thread-like riblets and faint spiral grooves or threads; the transverse sculpture on the post-nuclear whorls consists of heavy ribs with wide interspaces and number on the last whorl about 6 or 7; the spirals consists of strong revolving threads between wide, regular intervals; they number on the spire-whorls 4 or 5, and on the last whorl 11 or 12, with additional and more crowded spiral threads on the canal; the spirals cross the summit of the ribs, the intersections being subnodulous or rough; there is generally a strong, sutural cord or spiral above which the ribs do not extend; outer lip not thickened; canal slightly twisted and with a strong siphonal notch.

Length 11mm.; diameter 5.75mm.

Remarks.— Differs from the preceding species, by its harsher and more Muricoid type of sculpture.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Negritos.

Genus DORSANUM Gray

Dorsanum parinense n. sp. Plate 18, figs. 5, 6

Shell small, Columbelloid in form; spire long of about 5 or 6 whorls, pointed, acute and equal in length to the aperture; whorls nearly flat, the suture emarginated with a narrow band; last whorl rather large, the base strongly contracted so that its form is quadrate; surface smooth, except for a narrow, sutural band; anterior canal short with two strong spiral ribs or keels on each side of the siphonal groove; outer lip thin, the inner provided with callus, and a small sharp keel or plica on the anterior of the columella.

Length 22.5mm.; diameter 12.5mm.

Remarks.— In *Nassa lagunitensis* Woods, the shell is nearly smooth, or banded with incised spiral lines, the siphonal sinus is deep and bordered on the posterior side by a sharp keel or rib which encircles the beak or anterior canal. The shell is Columbelloid and resembles closely the species generally placed in the genus *Dorsanum* Gray. They differ from *Bullia* Gray, in having the sutures distinct and free from a cover of enamel.

Dorsanum lagunitense Woods is a common and characteristic Upper Eocene species. In the basal Saman, the shells are usually small, averaging from about 19 to 20mm. Woods's type specimens which came from the Lagunitas sandstones higher in the section, are larger between 30 to 32 mm. in height. In the Saman sandstones of the Chira valley, at the top of the Saman formation, the average size is still larger and individuals reaching a length of 40mm. are common. Except in matter of size, there is no other change of importance.

From *Dorsanum lagunitense,* the *parinense* differs by its smaller size, the last whorl is less evenly convex and the base sharply contracted so that in contour, the form is quadrate. The surface appears perfectly smooth, except for a narrow sutural band.

Locality and Geologic Occurrence.— Parinas formation, Keswick Hills.

Genus MELONGENA Schumacher

Subgenus CORNULINA Conrad

Melongena (Cornulina) levifusoides n. sp. Plate 17, fig. 1

Shell short fusiform, with a moderately high conic spire and shouldered, tuberculate whorls; whorls 6 or 7, the earliest spire-whorls with heavy, transverse ribs which on the succeeding whorls become tubercular and finally develop into stout spines; the zone between the suture and the shoulder is free from transverse sculpture; a second row of small spines is present on the body-whorl a short distance below the shoulder and emerges from the upper end of the aperture or suture; a fine, somewhat decussated sculpture of spiral lines is present above the second or lower row of tubercules; anterior canal with heavy spirals; aperture not preserved in the type specimen.

Height 35mm.; diameter 26mm.; (broken)

Remarks. — This is a long ranging species beginning in the basal Salina formation and continuing through the Parinas and Restin into the Upper Saman. A specimen from the Upper

Saman sandstones has been selected as the type, because of its better preservation, but except in the height of the spire, there is no other important variation to be noted between the shells from the different horizons.

In the majority of specimens, the anterior canal is broken, and they were at first thought to belong to the genus *Levifusus.* More complete specimens from the Parinas and Salina formations show a short, twisted or curved interior canal, a strong rib or basal fold and probably a perforate base. The *Fusus minax* Solander from the Bartonian of the Parisien Basin is very similar to the present species. It is referred to *Melongena* (*Cornulina*) by Cossmann and Pissarro (Cat. fossiles de l'Eocene, pl. 39, fig. 191-1). Direct comparison with specimens of *Fusus minax* in the Cornell Museum, show that the large Parisien shells have a somewhat longer anterior canal and stronger spines, but the young shells are extremely similar.

Localities and Geologic Occurrence.—
Salina formation, Negritos.
Parinas formation, Balcones Point.
Restin formation, Jabonillal.
Saman formation, Casa Saman.

Subgenus PUGILINA Schumacher

Melongena (Pugilina) œdicnema n. sp. Plate 17, fig. 2

Shell of medium size, Fasciolaroid; spire rather high, with strongly shouldered whorls, armed with short but stout, node or keel-like spines; sutures close; whorls 6 or more, strongly shouldered, the last or body-whorl with about 9, strong, broad node-like spines, sometimes continued below towards the base of the shell as low, subobsolete, transverse folds; the area above the shoulder is impressed or slightly concave, smooth and generally free from any sculpture except growth lines; the surface, from the shoulder angle and over the base and anterior canal, is sculptured with wavy, unequal spirals divided into a widely spaced primary set and with finer secondaries in between; anterior canal moderately long, curved with a feeble, encircling basal rib or fold; aperture Fasciolariod, widest at its posterior one-third, and continued anteriorly into a short, curved canal.

Length 39mm.; diameter 26mm.

Remarks.— The *Fusus subcarinatus* Lamarck, from the Bartonian of France, and referred by Cossmann to *Melongena* (*Pugilina*) Essais de Paléoconchologie, vol. 4, p. 88, pl. 4, fig. 11, is very similar to this species. Judging simply by the published figures, the French shell was somewhat stouter, the fold on the anterior canal is heavier, and the base is feebly perforate. In the only specimen we have showing the anterior canal, the base is imperforate, but in the other characters, *œdicnema* is very close to *subcarinatus* and they are unquestionably congeneric.

Locality and Geologic Occurence.— Saman formation, Casa Saman.

Family FUSIDÆ Tryon

Genus CLAVILITHES Swainson

Clavilithes pozœnsis n. sp. Plate 21, figs. 6, 8, 9

Shell fusiform, the spire acute and longer than the anterior canal; whorls 6 or more, convex, often subangled about the middle and with the portion of the whorl immediately below the upper suture contracted or excavated; the spire whorls are sculptured with about 8, transeverse ribs or swellings which are strongest on the middle of the whorl but lacking from the upper sutural area; the surface of each spire-whorl is overrun with 13 or 14 spiral threads with much wider intervals; the spirals and the regular, transverse growth-lines together form a fine, trellised-like sculpture which is best displayed on the spire-whorls and on the upper part of the body-whorl; on the body-whorl, the transverse sculpture is absent or obsolete, with the spirals strongest on the upper part of the whorl and the anterior canal, nearly smooth in the middle; anterior canal straight; aperture narrow or contracted, the inner lip with a pronounced callus, the inner edge is free or shelf-like.

Height 40mm.; diameter 15.5mm.

Remarks.— In general form, this shell does not resemble the majority of species of *Clavilithes*, and it is with some hesitation that I am referring it to that genus. It resembles *Clavilithes* rather than other Fusoid genera, in its comparitively short anterior canal, the shelf-like edge of its inner lip and in features of its aperture. Certain Parisian species of *Clavilithes* of the subgenus *Cosmolithes* Grabau, are remotely similar to the Peruvian species, but in that group, the columella is provided with a single sharp plication.

C. peruvianus Woods of the Salina — Parinas, differs by its larger size, finer sculpture and in lacking the transverse ribbing except on very young shells. The Saman species is peculiar in its apertural characters. The inner lip is provided with a large, protruding leaf-like edge and the outer lip is generally strongly impressed as if through crushing.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Lagunitas, and a few miles north of Negritos.

Clavilithes woodringi n. sp. Plate 21, figs. 1-3

Shell robust, with a moderately long, acute, spire; whorls 7 or more, the earlier ones more or less angled above and with deep, excavated sutures; the individual spire-whorls are cylindrical in form, nearly three times as wide as high; earlier spire-whorls are sculptured with 6, transverse ribs or swellings and fine spirals, but this sculpture rapidly becomes obsolete and the later whorls are smooth, except for faint and irregular, spiral lines or threads; the later whorls are less distinctly shouldered and the sutures are more deeply and narrowly excavated or canaliculate; last whorl is very large, cylindroid, and the base is strongly contracted to form the anterior canal.

Height 42mm.; diameter 33mm.; (type fragmentary)
43mm.; diameter 25.5mm.

Remarks.— The above description is based upon a number of imperfect specimens from the Saman conglomerate near Lagunitas. It differs from the *C. pacificus* Woods of the Restin and Parinas, in its higher and more cylindrical whorls and proportionately longer spire. Among European species, it is quite similar as may be expected to *C. macrospira* Cossmann of the Parisian Eocene and to *C. solanderi* Grabau from the English

Barton beds. From these European species, the Peruvian shell appears to have been more slender and the whorls more cylindrical.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate near Lagunitas.

Clavilithes lagunitensis n. sp. Plate 21, figs. 4, 7

Shell of moderate size, heavy, with a conic spire and a somewhat longer body-whorl and canal; whorls 6 or more; the earlier spire-whorls are sculptured with 5 or 6 strong, transverse ribs or swellings, fine spirals and a subobsolete sutural cord at the upper edge; on the later whorls the transverse ribs have become obsolete, the upper part of the whorl is strongly shouldered by a shelf-like or flattened band which follows just below the upper suture; sutures channeled or canaliculate; the shoulder of the whorl is angled or strongly carinate; the whole surface of each whorl is covered with fine, revolving spirals, weak on the middle of the body-whorl; anterior canal straight and the columella provided with two plications.

Height 42mm.; diameter 30mm.; (type)
53mm.; diameter 24mm.

Remarks.— This species appears to be a direct descendant of the earlier *C. incertus* Woods of the Salina - Parinas formations. It differs by its larger size, and in details of sculpture and form. In *incertus,* the portion of the whorl immediately below the shoulder is deeply contracted or sunk, and the carinate shoulder is heavier and more cord-like in appearance.

Woods in his description of *incertus,* compared it with the *Rhopalithes Noœ* Chemnitz from the Parisian Eocene and noted the indication of a columellar plication. In a cross-section of one of our specimens, the columella is shown with two strong oblique plications. *Rhopalithes* was proposed by Grabau, as a generic form distinct from *Clavilithes,* in the shape of its protoconch and in having two columellar plications. In addition to *R. Noœ* the type species, there are several other forms in the European Eocene, but *incertus* and *lagunitensis,* seem to be the first species of the *Rhopalithes* series to be recorded form America.

Locality and Geologic Occurrence.— Saman formation horizon of the Saman conglomerate near Lagunitas.

Xancus peruvianus n. sp. Plate 21, fig. 5

Shell large or medium size, solid and heavy; spire about the length of the aperture with 4 plus whorls (the tip broken); whorls narrowly shouldered and the shoulder angle armed with numerous, feeble ribs or nodes, strongest on the spire whorls; the area between the shoulder angle and the suture is slightly concave or excavated and with an appressed band or feeble cord about the suture; below the shoulder, the sides of the spire-whorls are straight; the side of the body-whorl is straight, contracted in the region of the base and then prolonged into the long, anterior canal; sculpture as noted, consists of feeble ribs or nodes on the shoulder angle, roughly numbering about 15 to 17 on the last whorl, and weak irregular spiral threads, lacking or subobsolete from the middle and upper part of each whorl, but strong and heavy on the anterior canal; inner lip with a wide, spreading callus and the columella is provided with three strong plicæ, the upper 2 being stronger.

Height 85mm.; diameter 47mm.; (Chira Shales)

Remarks.— In describing this species, I have selected as the type form, a specimen from the Chira shales of Lower Oligocene age. In the Upper Eocene, the species occurs in the Saman formation, and a few very poorly preserved specimens have also been found in the Restin sandstones of Upper Middle Eocene age. The Eocene shells are not well preserved but differ only in a varietal degree from the Oligocene forms. In the Saman specimens, the sculpture is somewhat coarser, the shoulder ribs or nodes are heavier and more persistant and the size of the shell is less.

The discovery of a typical *Xancus* in the Peruvian Eocene, extends the known stratigraphic range of this genus from the Lower Oligocene into the upper part of the Middle Eocene. The *X. wilsoni* Conrad from the Vicksburg Oligocene, is quite similar to *peruvianus,* but it differs in having a less pronounced shoulder and the sutural area is wider.

Localities and Geologic Occurrence.—

Restin formation.

Saman formation, Caleto Sal, Casa Saman.

Chira formation, Chira shales near Casa Saman.

Genus VOLUTA Linné

Subgenus PERULUTA n. subg.

The following is a description of the subgenus *Peruluta*. Type, *Eovasum peruvianum* H. Douvillé.

Shell Fulguroid to short Volutiform, whorls strongly shouldered, typically bearing spine-like tubercles or extensions sometimes lacking; spire-whorls free or covered with callus; columella with 3 strong, slightly oblique and *Voluta*-like folds; a deep siphonal notch, bordered on the posterior side by a strong, encircling ridge or keel, a deep anal or posterior sinus adjacent to the suture.

Voluta (Peruluta) peruviana H. Douvillé

Eovasum peruvianum H. Douville, 1921, Journ. de Conchyliologie, p. 3, 4 pl. 1, figs. 4-5.

Volutospina peruviana Woods, 1922, p. 101, pl. 14, figs. 5-7; pl. 15, figs. 1-5

H. Douvillé referred this species to his genus *Eovasum,* the type of which, is the *Turbinella frequens* Mayer-Eymar[19] from the Eocene of Egypt. Douvillé's Peruvian specimens were fragmentary and superficially they resemble quite closely the type species *E. frequens,* but they differ in having 3 instead of 4 columellar folds and particularly in lacking the heavy, *Melongena* or *Vasum*-like cord about the base of the shell. More perfect specimens, than those which Douvillé had for study, clearly show as Woods has maintained, that the relations of these fossils are with the Volutids, but without fully agreeing with any of the established generic or subgeneric types. From *Volutilithes* Swainson (*Plejona* Bolten), and its subgenera, they differ in their strong, columellar plicæ, deep siphonal notch which is bordered on the posterior side by a strong keel. These characters relate the shells with the true *Voluta* Linné. The protoconch is not preserved in our specimens but it was probably small. From *Voluta* Linné, the Peruvian shells differ markely in form, being shorter and more stubby or Fulguroid (*V. mancorensis*), with a sharp shoulder, free or provided with strong, spines or tubercles. *V. peruviana* is strongly phylogerontic and in the middle and upper portion of its geologic range, gerontic characteristics are developed in early life, such as the spreading of a heavy callus deposit over the spire-whorls.

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[19] Mayer-Eymer, Journ. de Conchyl. vol. 43, p. 47, pl. 2, fig. 7; vol. 66, p. 1, 2. pl. 1, figs. 1a, 1b.

This species and its varietal forms are among the commonest and most characteristic fossils of the older Peruvian Eocene. Beginning in the Negritos formation, the species ascends as high as the Lower Saman. It early begins to assume gerontic characteristics, which appear earlier and earlier in the higher beds, and upon these features, two principal varieties, aside from the typical form may be recognized. These varieties have a distinct stratigraphic significance and have been carefully described and figured by Woods but grouped together under the same specific name of *peruviana.*

Douvillé and Woods' description applies best to specimens from the Negritos formation, which should therefore be selected as the typical form. The shoulder ridge is strong and bearing 9 or 10 spine-like tubercles, which are equally as strong on the spire-whorls. The callus deposit is lacking or very slight.

In the Salina formation, the callus covers the greater part of the spire-whorls, usually leaving the tip of the spire and the earliest whorls free. The shoulder of the last whorl is provided with heavy tubercler or spines which are covered by the callus or submerged by the sutures. The spire in uniformly low. This variety is most common in the Salina formation or the basal *Clavilithes* series and should be designated as variety *salinensis* n. var. It is represented by Woods' figures 1 and 2, on plate 15.

The variety *salinensis,* continues into the Parinas (fig. 4, plate 15, of Woods). In the Parinas however, we find the introduction of a third form, illustrated by Woods' figures 3 and 5 and our own on plate 22, figs. 4, 5. (also pl. 16, fig. 8). It reaches its best development in the basal Saman but shortly disappearing and its place being taken by *V. mancorensis.* In this variety the callus is developed to an extreme, often covering the entire spire in an *Orthaulax*-like manner. The shoulder of the whorl is rounded, entirely free from spines, and the sutures are closely appressed. It should be specially noted that even in very young shells from the Parinas (length 19mm.) and apparently at all stages in the basal Saman, the shoulder is well-rounded, smooth and with a heavy deposit of callus. This variety should be designated as var. *samanica* n. var.

Locality and Geologic Occurrence.— Negritos formation, Negritos, La Brea (typical form) ; Salina formation, Negritos, L Brea, (var. *salinensis*) ; Parinas formation, Negritos, (var. *salinensis* and *samanica;* Restin formation, variety *salinensis* and *samanica* Jabonillal; Saman formation, horizon of the Saman conglomerate near Negritos, var *samanica.*

Voluta (Peruluta) mancorensis n. sp. Plate 22, figs. 1, 3

Shell large, heavy, Fulguroid; spire low, but elevated and acute; whorls about 6, strongly sculptured and with large, heavy spine-like tubercles, which number on the last whorl from 9 to 11; the tubercles and spines are confined to the shoulder angle, leaving the sutural area smooth as well as the surface of the whorl below the shoulder; aperture is sub-elliptical, widest at the lower on anterior one-third; in mature shells the anal sinus is deep and narrow, lying along the upper suture; inner lip or body of the whorl is free from callus, except as a very thin deposit in certain large specimens; columella with three strong, more or less oblique plicæ, the posterior or upper one being the largest; anterior or siphonal sinus is fairly deep, bordered above by a sharp ridge which is continued as a sharp keel or rib around the anterior canal, ending midway between the upper and second columella plicæ; the trace of the siphonal sinus is bordered below or on the anterior side by a second and strongly oblique rib, and a faint fold is developed above the upper keel.

Height 62mm.; diameter 41mm.; (type)

Remarks.— The relations of this shell is clearly with the stock of *V. peruviana.* In addition to its much larger size, it differs from *peruviana* by its generally higher spire, more flaring outer lip and the general lack of callus deposit on the body-whorls and over the spire. *V. mancorensis* is a relatively stable species and in its long range through the Upper Eocene and Oligocene beds, it shows no important changes or variations. *V. peruviana* on the other hand belongs to a highly phylogerontic stock and became extinct in early Upper Eocene times.

Locality and Geologic Occurrence.— Saman formation, quite common specially in the Upper part, as the Saman sandstones of the Chiro Valley and Paita; Chira formation, several localities in the Chira valley, the Sal Chica beds of Punta Sal etc; Mancora formation, Chira valley, Mancora, Punta Sal etc; Heath formation, Caleto Mero, Mancora.

Genus LYRIA Gray

Lyria sabulosa n. sp. Plate 17, figs. 7, 8

Shell elongate-ovate, with a long, relatively narrow aperture and a shorter spire about one-half the length of the aperture; the nucleus is rather large, obtuse and formed of three, smooth whorls, followed by two or more subsequent whorls; sutures appearing canaliculate or excavated by a slight coronation of the upper edge of the whorls; spire-whorls, except the nuclear are flat and divided by the excavated sutures; last whorl, large, but not inflated, evenly convex passing anteriorly into a moderately long and somewhat twisted, anterior canal; the sculpture consists of even, transverse ribs or waves, often continuous across the whole shell, but on the larger shells, subobsolete on the base; aperture long and narrow, the outer lip thickened with an external rib; anterior or siphonal sinus was probably moderately deep, showing in the growth lines or the canal as a strongly, oblique band, bordered on each side by a low rib; columella concealed.

Height 37mm.; diameter 20.5mm.

Remarks.— A very common and characteristic species in the Saman conglomerate. It differs from *Lyria mississippiensis* Conrad[20] from Vicksburg by its generally larger size and deeply excavated sutures.

Locality and Geologic Occurrence.— Saman formation, horizon of the Saman conglomerate, Negritos, near Lagunitas.

Family OLIVIDÆ d'Orbigny

Genus OLIVELLA Swainson

Olivella vicana n. sp. Plate 18, figs. 11, 12

Shell small, smooth, with a moderately high, acute spire; whorls about 7, the first 3 belonging to the small, obtuse nucleus; the post-nuclear spire-whorls are flat or straight-sided and separated by deep, canaliculate sutures, above which there is often a bordering, narrow band of callus; body whorl large, slightly convex, widest about the middle; surface smooth generally white or faintly blotched; aperture narrow, widest anteriorly and nearly two-thirds the full length of the shell; outer lip sharp, pillar straight; the anterior or siphonal sinus is deep and with a broad fasciole, with 2 strong, oblique ribs at the lower end of the columella.

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[20] Conrad as *Fulgoraria mississippiensis*, Journ. Acad. Nat. Sci. Phila. vol. 1, pl. 13, fig. 1.

Length 16mm.; diameter 6mm.

Remarks.— A very common species in the Restin rocks of Jabonillal. According to figures, it resembles closely the *O. mitreola var. mucronata* d'Orbigny from the Parisian Eocene, but our shells are somewhat larger.

Locality and Geologic Occurrence.— Restin formation, Jabonillal.

Genus OLIVANCILLARIA d'Orbigny

Subgenus AGARONIA Gray

Olivancillaria (Agaronia) saxosa n. sp. Plate 18, figs. 8, 9

Shell rather slender with a high spire and deep, canaliculate sutures; the spire is high and pointed and slightly less than one-half the total length or height of the shell; whorls 5 plus (the apex broken in all our specimens) and separated by deep, grooved or canaliculate sutures; between the last and the penultimate whorls, the sutures may be bordered above by a callus thickening which passes a short distance down along the parietal side of the aperture; the last whorl is subcylindrical in form and slightly convex just about the middle and it carries about the lower or anterior one-third, a wide band, and below this, two grooves, the lower of which passes into the siphonal sinus; aperture comparatively narrow, widest about the middle.

Height 45mm.; diameter 15mm.

Remarks.— Our specimens are fragmentary and the surface of the shell weathered and eroded. From *Oliva alabamensis* Conrad from the Claiborne Eocene, it differs in being more slender, the body-whorl is less convex and the aperture appears to be narrower. According to Cossmann, two typical species of *Agaronia* occur in the Eocene of the Basin de Nantes;

O. Dubuissoni Vass., and *O. oxyspira* Cossm. *O. Dubuissoni* resembles the Peruvian species quite closely but the penultimate whorl is wider and the shell is less slender.

Locality and Gological Occurrence.— Saman formation, Saman congl., near Lagunitas.

Subclass EUTHYNEURA

Order OPISTHOBRANCHIA Milne Edwards

Family AKERATIDÆ Pilsbry

Genus HAMINEA Leach

Haminea labrea n. sp. Plate 20, fig. 6

Shell thin, broadly ovate, ventricose; body-whorl very large and completely enveloping the shell with each volution; aperture rather wide, contracted or narrowed posteriorly and continued to and above the summit of the shell; the summit of the shell is slightly concave in the center but apparently not umbilicate; external surface appears to have been smooth.

Height 44mm.; diameter 34mm.

Remarks.— Two specimens of this species, partly internal casts have been collected from the *Turritella* beds of La Brea. In size and general form, this species recalls the *Haminea grandis* Aldrich from the Jackson Eocene, but the Peruvian species appears to have been smooth. The substance of the shell was probably very thin, and for this reason, the shells are referred to *Haminea* rather than to *Bullaria* Raf.

Locality and Geologic Occurrence.— Negritos formation, La Brea.

Haminea solaria n. sp. Plate 20, figs. 2, 4

Shell large, ventricose, broadly-ovate or subspherical in form; aperture wide, full and not extending much above the summit of the shell; summit is somewhat flattened with a narrow, deep umbilical-like pit.

Height 65mm.; diameter 59mm.

The type specimen is an internal cast from which all trace of the original shell has been removed and the surface of the cast is encrusted with patches of worm tubes. The general form of the shell may be gained from the specimen and because of its unusual size, and relations with the preceding species, it is worthy of notice.

Fron *H. labrea,* it differs by its large size, more subspherical form and wider aperture. The cast shows a narrow, deep, umbilical-like pit in the summit, but on the external shell, this pit may have been shallow as in *H. labrea.*

Locality and Geologic Occurrence.— Restin formation, base of formation at Balcones Point.

Class CEPHALOPODA

Order NAUTILOIDEA Zittel

Family CLYDONAUTILIDÆ Hyatt

Genus HERCOGLOSSA Conrad

Hercoglossa peruviana Berry Plate 23, fig. 1

Hercoglossa peruviana Berry, 1923, Amer. Journ. Sci., vol. 6, p. 427-431, figs. 1, 2.

This fine Nautilod, described by Professor Berry from specimens sent to him by Senor Jose J. Bravo of Lima, is quite common near the top of the Restin sandstones at Lobitos. It seems to be strictly limited to this horizon, and from its abundance at its type locality, the coastal point near by, has been named Punta Nautilus by the Lobitos geologists and engineers. The species becomes very large and specimens attaining a maximum diameter of 2 to 300 mm. are not uncommon. A small specimen has been figured to show the strong suture lines and for more ready comparison with the Peruvian species of *Eutrephoceras.*

H. peruviana is obviously most closely related to *H.* (*Enclimatoceras*) *ulrichi* White from[21] the Midway Eocene of the southeastern United States. *H. ulrichi* differs from *peruviana* as pointed out by Professor Berry, by its usually smaller size, narrower venter, more inclined sides, in its smaller and more centrally located siphuncle, and in details of its suture lines.

Locality and Geologic Occurrence.— Restin formation, Lobitos.

Genus ATURIA Bronn

Plate 24, figs. 1, 3
Plate 25, figs. 1, 6

Of the Peruvian Nautiloids, *Aturia* is the most common and widespread. The earliest specimens occur at the very base of the Salina formation, where they are often quite common, but generally so encrusted with a sandy matrix, that for a long time their true relationship could not be established. No specimens have as yet been discovered in the Pale Gredas or Parinas sandstons, and their next occurrence is near the top of the Restin sandstones at Lobitos, associated with *Hercoglossa peruviana* Berry. In the Upper Eocene, Aturias are fairly common, and have been collected from several horizons within the Saman formation. The Saman conglomerate specimens are usually very small and immature, but at several localities in the Saman sandstones of the Chira valley, they are quite large, fully 2-300 millimeters or more in diameter. They continue to be fairly common fossils throughout the Peruvian Oligocene and are recorded from several localities in the Chira, Mancora and Heath formations. In the Mirador sandstones and conglomerates of the Chira valley, and considered as of Middle Oligocene age, Boughton has collected specimens nearly as large as those of the Upper Saman sandstones. No Aturias have been discovered in the Peruvian Miocene to date.

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[21] White, C. A., U. S. Geol. Survey, Bull. 3, p. 17, pls. 7-9.
Harris, G. D., Bulls. Amer. Pal., Vol. 1, No. 4, p. 236-239, pls. 13, 14, 15.

The Genus *Aturia* was established by Bronn, in 1838, with *A. zic-zac* Sowerby and Eocene fossil from the London clay as the type species. Fischer[22] credits the genus with 6 species, widely distributed in the Eocene-Miocene rocks of Europe, Egypt, India and North America. Most of the species are very similar, and it is still a question, how many really distinct species should be recognized. Of the Eocene forms, the contour of the shell is always very similar as well as the minute details of the suture lines. The characters of the funnels and siphuncle have greater value but are less commonly preservd. For comparing the Peruvian Aturias with the described and figured species in the literature, use has been made of the relative proportions of the greater diameter of the shell to the semi-thickness. These proportional values seem to be quite constant and reliable.

The typical English *A. zic-zac,* as figured by Sowerby and Edwards[23] is a small species, rather ventricose and with an elongate-elliptical aperture. Its proportion is in the ratio of 1 to 4.8. A large species nearly equaling the Saman sandstone specimens in size, was described by Parona[24] as *A. rovasendiana* from the Upper Eocene rocks of the Italien Piedmonte. The suture lines as figured agree exactly with the Peruvian Aturias, but the shell is more strongly compressed, with a proportional ration 1 to 7.

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[22] Fischer, 1887, Manuel de Conchyliologie, p. 415.

[23] Edwards, Eocene Mollusca, Paleontographical Society of London, vol. 21, p. 52, pl. 9, figs. 1, 2.

The Eocene rocks of the Atlantic coastal plain of the United States, have two described species of *Aturia,* the *A. alabamensis* Morton[25], from Claiborne Alabama, and the Castle Hayne marls of South Carolina, and *A. vanuxemi* Conrad from the greensand marls of New Jersey. *A. alabamensis*[26] is very similar to *vanuxemi,* but it differs in being somewhat less compressed and in the shape of the siphuncle.

Whenever, preserved, the suture lines of the Peruvian Aturias are similar in every detail with those figured for the European and American Eocene species. The siphuncle is quite small and situated closely adjacent to the venter of the next inner volution. The funnels are long, uniting to form a long, continuous and relatively small siphuncle tube, lying on or just above the venter of the inner volution. The exterior is smooth, with strongly curved growth lines, on the sides strongly convex forward and uniting on the venter to form a wide, shallow sinus.

The proportional ratio of European and American Eocene species compared with the Peruvian specimens is as follows:

A. zic-zac Sowerby, portion 1 to 3.

A. rovasendiana Parona, porportion 1 to 7.

A. alabamensis Morton,[27] porportion 1 to 4.3.

53-56 Taf. III

A. vanuxemi Conrad porportion 1 to 6.

The Peruvian porportions:

The Salina formation specimens porportion 1 to 3.

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[24] Parona, Celalopodi terziara del Piemonte, Pal. Italica, vol. 4, p. 157, pl. 12, fig. 1, pl. 13, fig. 1.

[25] Morton, Synopsis of the organic remains of the Cretaceous group, p. 33. pl. 18, fig. 3.

[26] Kellum, Paleontology and Stratigraphy of the Castle Hayne and Trent marls, Prof. Paper 143, U. S. Geol. Survey.

[27] For a good figure of *alabamensis* see Geinitz, Ueber *Nautilus Alabamensis* Morton, N. *zic-zac* Sowerby und N. *lingulatus* Von Buch Neues Jahr. fur Min. Geol. und Pal., 1887, vol. 2, p.

The Saman and Oligocene specimens porportions 1 to 4.

From the above data, the Peruvian fossils seem to divide into two groups, the earlier specimens from the Salina formation, or basal Middle Eocene, with porportional ratio quite close to the typical *A. zic-zac* of Europe; and the Upper Eocene and Oligocene specimens, more obviously related to the American *A. alabamensis* of Morton. The Salina specimens are poorly preserved and until better specimens are obtained, more detailed comparisons cannot be made. The porportions of the Upper Eocene and Oligocene specimens are quite constantly 1 to 4, and it is believed that they should be considered as a variety of *alabamensis*, which may be designated *peruviana*.

Dimensions:

Middle Eocene	Greater Diameter	Least Diameter	Semi-thickness
Salina formation			
a.	103mm.;	82mm.;	31mm.
b.	104mm.;	74mm.;	30mm.
Variety *peruviana* n. var.			
Upper Eocene			
Saman congl.	24mm.;	inperf.	6mm.
Saman sandstones	200mm.;	150mm.;	50mm.
Middle Oligocene			
Mancora formation			
(Mirador congl.)	60mm.;	45mm.;	14.5mm.
Upper Oligocene			
Heath formation			
(Cone Hill Sh.)	33mm.;	26mm.;	8.75mm.
	25mm.;	19mm.;	6.75mm.

Family NAUTILIDÆ Owen

Genus EUTREPHOCERAS Hyatt

Eutrephoceras negritensis n. sp. Plate 26, figs. 1, 2

Shell of medium size, stout, rather globose, the width or thickness of the last volution being about three-fourths the greater diameter of the whole shell; the whorls are strongly involute, but leaving a small, rather deep, narrow and partially closed umbilicus; they are moderately rounded on the venter slightly flattened on the sides and possibly slightly auriculate on the umbilical angle in full-grown individuals; the septa follow at regular intervals and with nearly straight sutures, but like those of *Eutrephoceras* possessing sometimes a shallow or nearly straight ventral lobe (usually straight in young shells), a weak ventrolateral saddle, shallow lateral lobe, a strong lateral saddle on the umbilical angle, and an umbilical lobe; the siphuncle is small and dorsocentren in position; substance of shell is rather thin, with strong, crowded, curved growth lines, convex forward on the sides and meeting on the venter to form a wide, shallow sinus.

Greater diameter 86mm.; lesser diameter 61mm.; thickness 66mm.

Remarks.— *Eutrephoceras* seems to be more typically an Upper Cretaceous Nautiloid, but in recent years, 3 or possibly 4 species have been described or referred to this genus, from the Eocene rocks of the Eastern and Southeastern part of the Coastal plain of United States. They include the *E. cookana* Whitfield[28] from the Shark River beds of New Jersey, *E. sloani* Reesides,[29] and *E. carolinensis*[30] Kellum from the Carolinas. *Enclimatoceras vaughani* described by Gardner[31] from the Midway of Texas, judging by the nearly straight suture lines should probably be referred to this genus also. *Nautilus sowerbyanus* White non d'Orb.,[32] from the Maria Farinha e Olinda beds of Pernambuco, Brazil probably belongs to this genus. As figured, White's shell resembles quite closely *negritensis,* but is more globose, the venter is even more widely rounded and the suture-lines appear to be nearly straight.

The type material of *negritensis* consists of 4 specimens collected together in the lower part of the Pale Gredas, about two miles east of Negritos.

Locality and Geologic Occurrence.— Pale Greda formation, Negritos.

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[28] Whitfield, R. P., Gasteropoda and Cephalopoda of the Raritan clays and Greensand marls of New Jersey, Mon. 18, U. S. Geol. Survey, pp. 285-286, pl. 48, fig. 1; pl. 49, figs. 4, 5.

[29] Reeside, J. B., A new nautiloid cephalopod *Eutrephoceras sloani* from the Eocene of South Carolina, Proc. U. S. Nat. Mus., Vol. 65, pp. 2-4, pls. 1, 2.

[30] Kellum, L. B., Paleontology and stratigraphy of the Castle Hayne and Trent marls in North Carolina, Prof. Paper 143, U. S. Geol. Survey, p. 32, pl. 7, figs. 5-7.

[31] Gardner J., New species of mollusca from the Eocene deposits of southwestern Texas. Prof. Paper 131-D, U. S. Geol. Survey, p. 115, pl. 33, figs. 1-3.

[32] White, C. A., Contributions to the Paleontology of Brazil, Archivos do Museu Nacional de Rio Janerio, Vol. 7, p. 230, pl. 25, figs. 1-4.

Eutrephoceras haughti n. sp. Plate 23, fig. 2

Shell small, (the type measuring about 61 mm. in maximum diameter) but moderately convex, the thickness of the last volution being about one-half the greater diameter; the whorls are strongly involute, but leaving a small, narrow, umbilicus; the last whorl is narrowly rounded on the venter, slightly flattened on the sides, and noticeably angled on the umbilical shoulder; the septa are regularly spaced with simple suture lines typical of the genus, with a nearly straight ventral lobe (if it may be so called), a ventro-lateral saddle lateral lobe, a strong lateral saddle on the umbilical shoulder and an umbilical lobe; siphuncle not visable; external surface unknown.

Greater diameter 61mm.; lesser diameter 46mm.; thickness 35mm.

Remarks.— This species differs from *negritensis,* not only by its smaller size, but is more compressed, with flattened sides and a fairly strong, umbilical angle or shoulder. The type specimen was collected by Mr. Oscar Haught near Lagunitas, probably from shales belonging to the Saman formation.

Locality and Geologic Occurrence.— Saman formation, Lagunitas.

Phylum MOLLUSCOIDEA

Class BRACHIOPODA Dumeril

Order TELOTREMATA Beecher

Superfamily TEREBRATULACEA Waagen

Family TEREBRATULIDÆ Gray

Genus LIOTHYRINA Oehlert

Liothyrina peruviana n. sp. Plate 25, figs. 2-5

Shell of medium size, moderately but not strongly convex, glabrous; dorsal valve subcircular to suborbicular, usually with a faint, broad fold showing only on the basal margin; ventral valve subelliptical, widest about the middle, with pointed beak and broady rounded basal margin; umbo full and prominent ending above in the slightly curved beak; foramen moderately large, circular.

Length 24.5mm.; breadth 23mm.; diameter 14mm.
25mm.; breadth 23mm.; diameter 14.5mm.; (type)

Remarks.— *Liothyrina peruviana* associated with a fauna of *Orthophragmina peruviana* and several special mollusks, is a common and very characteristic fossil of the base of the Upper Eocene or horizon of the Saman conglomerate in the Negritos region. It occurs at the same horizon at Lobitos and specimens have been collected near Punta Mero, associated with stellate *Orthophragmina.* In all these localities, this brachiopod has a very limited stratigraphic range, although often very common.

Several species of Terebratuloid brachiopods have been noted or described from the Upper Eocene rocks of Colombia, Trinidad, and St. Bartholomew. In the Colombian localities with which I am acquainted, they occur near the base of the Upper Eocene or at a horizon equivalent to the Peruvian.

Three species of *Liothyrina* were described by Guppy[33] from the San Fernando beds of Trinidad, as *trinitatensis, carneoides* and *lecta.* In form, *peruviana* is most like *lecta,* but is wider and more depressed. *Liothyrina vaughani* Cooke[34] from the St. Bartholomew limestones is a much larger species reaching a length of 43mm.

Localities and Geological Occurrence.— Saman formation, horizon of the Saman conglomerate, 1 mile south of Negritos, Pozo valley near Lagunitas (type locality), Lobitos, near Organo Grande, Que. Canoas near Punta Mero.

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[33] Guppy, On Tertiary Brachiopoda from Trinidad, 1866, Quart. Journ. Geol. Soc., vol. 22, p. 296, pl. 19, figs. 1-3.

[34] Cooke, Contr. to the Geology and Paleontology of the West Indies, 1919, Carnegie Institiute of Washington, pt. 4, p. 152, pl. 16, figs. 1a-c.

Printed plates furnished for the edition by the author

Explanation of Plate I

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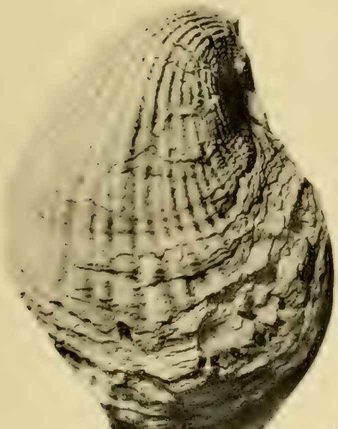
3.	**Ostrea samanensis** n. sp Holotype, exterior of left valve, natural size. Casa Saman.	17
4.	**Ostrea samanensis** n. sp. Exterior of right valve, about natural size. Casa Saman	17
5.	Holotype, exterior of left valve, natural size.	



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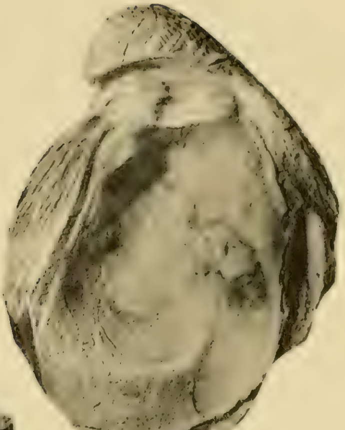

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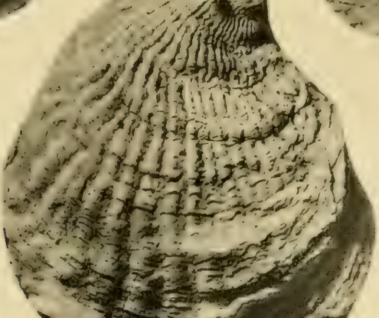

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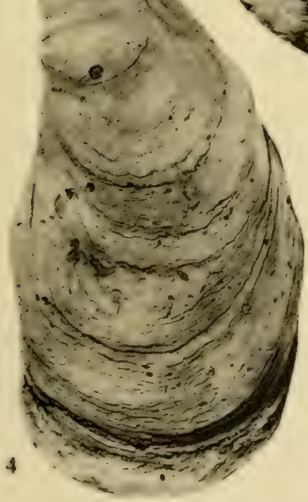

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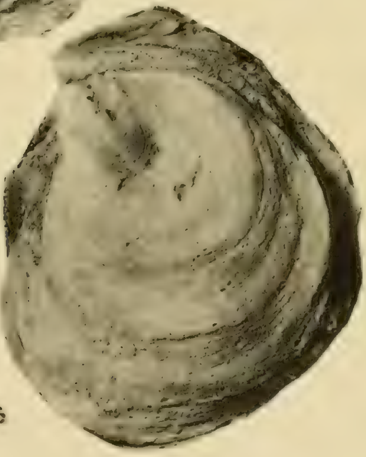

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Explanation of Plate 2

Figure Page

1. **Carolia (Carolia) peruviana** n. sp. 19
   Exterior of left valve, about natural size.
   Restin sandstones of Jabonillal (Holotype)
2. **Anomia septenaria** n. sp. 18
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   Restin sandstones of Que. Salado
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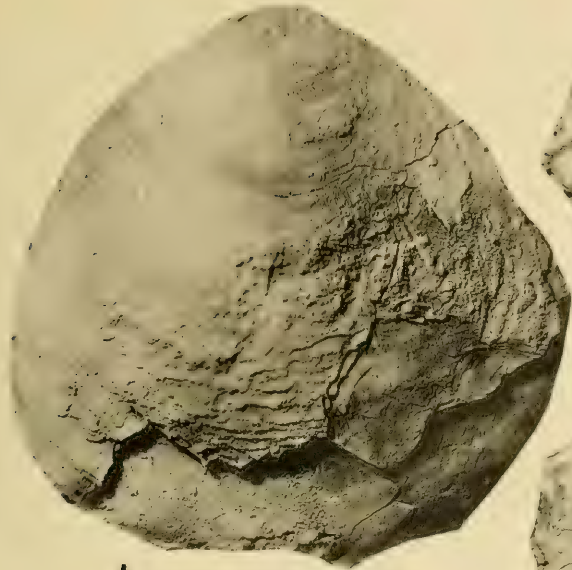
   Fragmentary beak of the left valve, nat. size.
   Negritos formation, Negritos
5. **Ostrea negritensis** n. sp. 16
   Exterior of left valve, natural size.
   Negritos formation, Negritos (Holotype)
6. **Ostrea negritensis** n. sp. 16
   Interior of same, natural size.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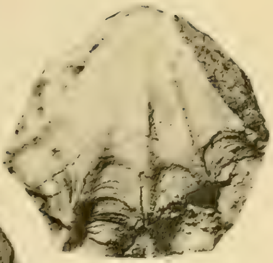
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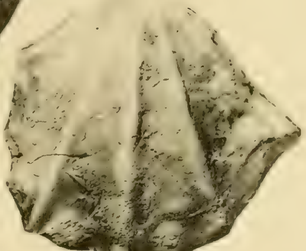
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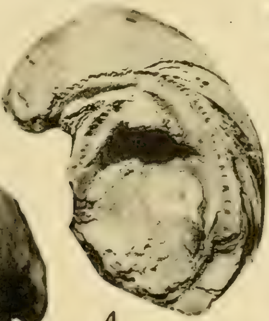
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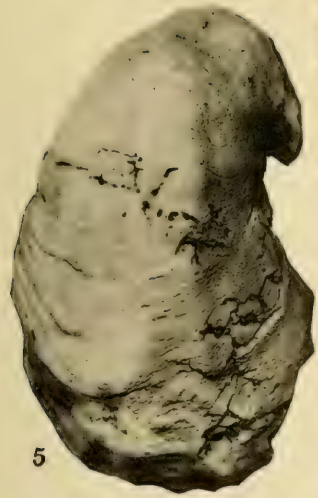
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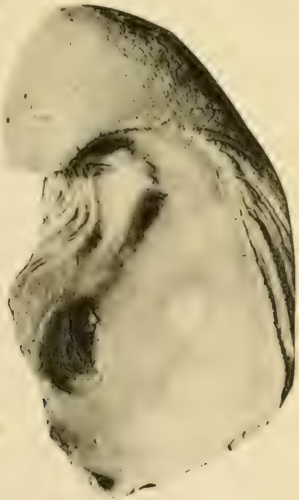
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Explanation of Plate 3

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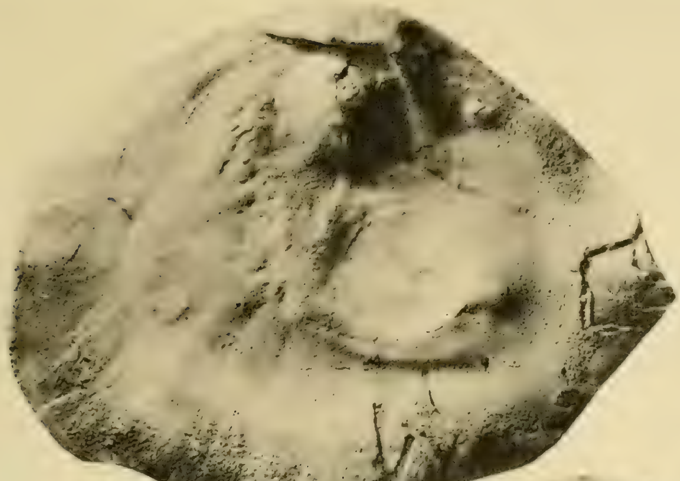
   Holotype, interior of right valve to show chondrophore, byssal foramen and adductor muscle scar.
   Parinas formation, near Negritos
2. **Carolia (Parinomya) parinensis** n. sp.
   Exterior of beak of right valve, showing the chondrophore free
3. **Carolia (Parinomya) parinensis** n. sp.
   from the dorsal-anterior margin and open byssal foramen.
   Exterior of beak of right valve with open byssal foramen
4. **Carola (Parinomya) parinensis** n. sp.
   Exterior of left valve, showing the rasp or pectinate sculpture on the anterior submargins



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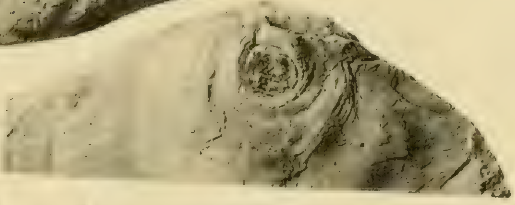

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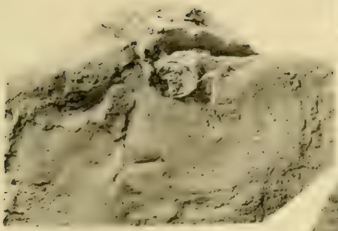

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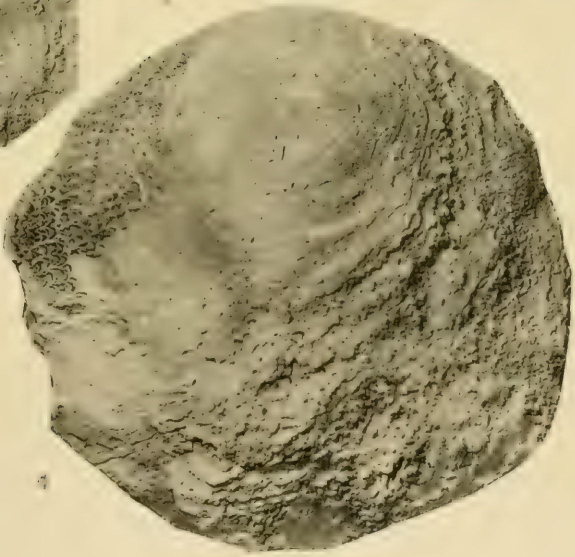

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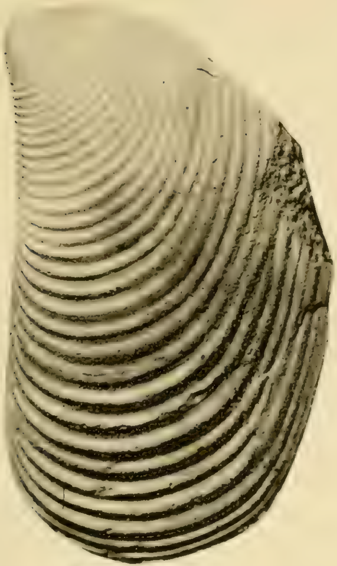
5.	**Amotapus arbolensis** Woods Greatly enlarged view of a small specimen with the beak of the right valve broken away revealing the chondrophore of the right valve Parinas formation, Keswick Hills	22



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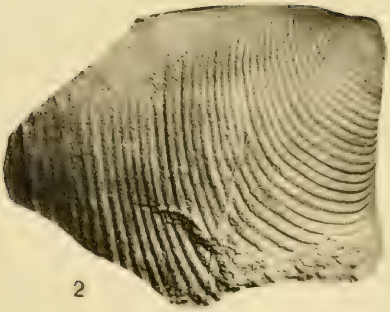

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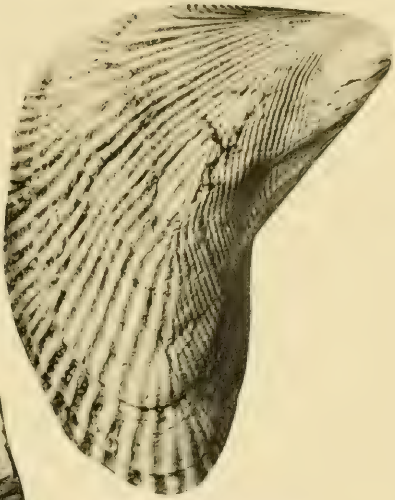

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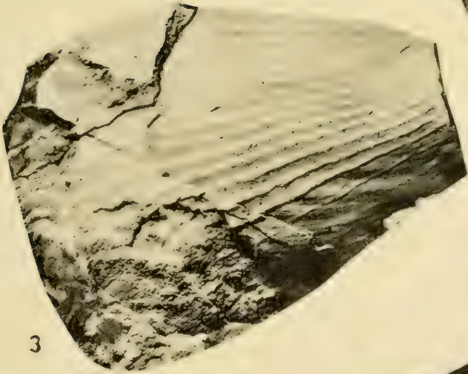

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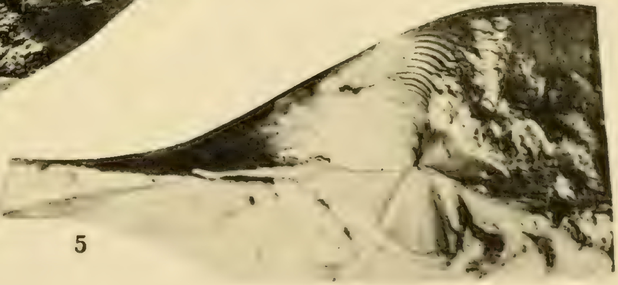

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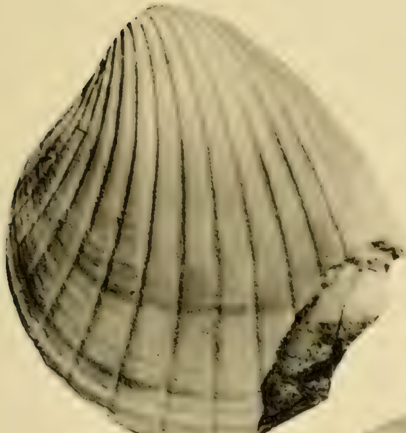
Explanation of Plate 5

Figure Page

1. **Venericardia planicosta** var. **negritensis** n. var. 26
   Holotype, height 76, length 70mm.
   Negritos formation, Negritos
2. **Venericardia planicosta** var. **negritensis** n. var. 26
   Cotype, height 75, length 76, diameter 38mm.
   Negritos formation, Negritos
3. **Venericardia planicosta** var. **parinensis** n. var. 26
   Holotype length 85, height 70, semi-dameter 32mm.
   Parinas formation, Keswick Hills
4. **Venericardia planicosta** var. **samanensis** n. var. 28
   Cotype, length 75, height 80, diameter 63mm.
   Restin formation, Que. Salado
5. **Venericardia planicosta** var. **samanensis** n. var. 28
   Holotype, length 94, height 100, diameter 65mm.
   Saman formation, Casa Saman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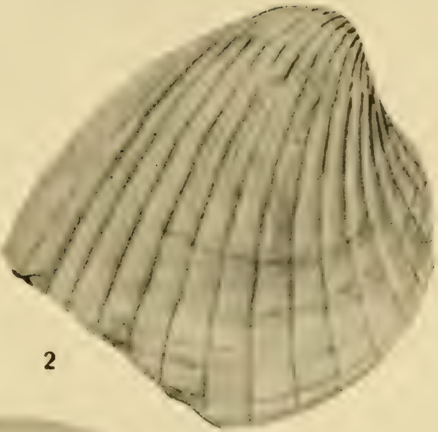
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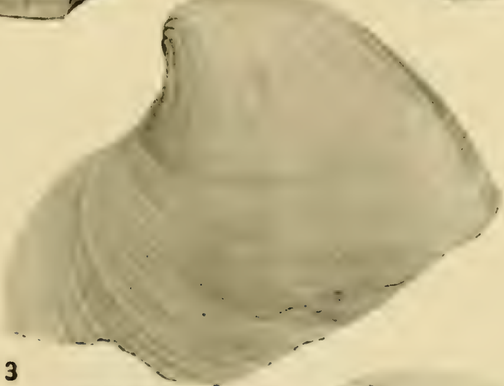
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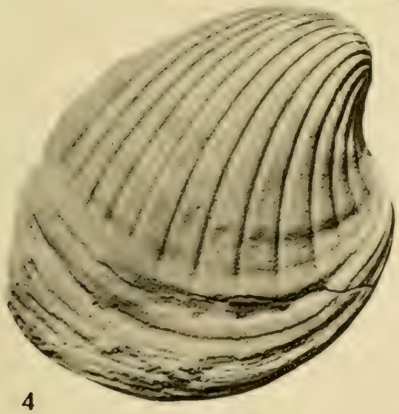
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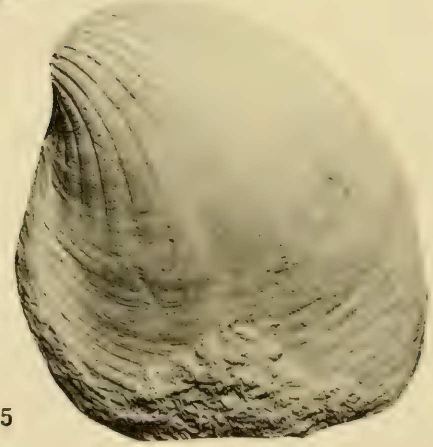
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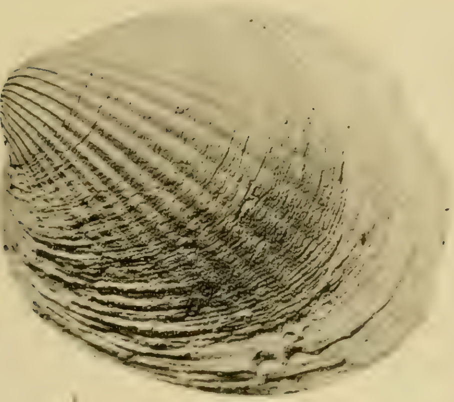
Explanation of Plate 6

1. **Venericardia peruviana** n. sp. 29
Holotype length 80mm.
Salina formation, Negritos
2. **Venericardia planicosta** var. **restinensis** n. var. 27
Holotype, length 42, height 39, semi-diameter 15.5mm.
Restin formation, Pozo valley
3. **Venericardia pacifica** n. sp. 30
Holotype, length 41mm.
Salina formation, Negritos
4. **Venericardia pacifica** n. sp. 30
Holotype, right valve
Salina formation, Negritos
5. **Venericardia pacifica** n. sp. 30
Dorsal view of same specimen as figs. 3, 4.
6. **Venericardia planicosta** var. **samanensis** n. var. 28
Salina formation, Saman congl., near Negritos.
Cotype, an immature left valve, length 51mm.



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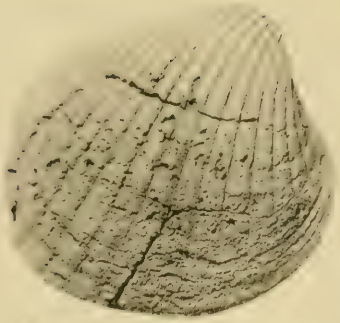

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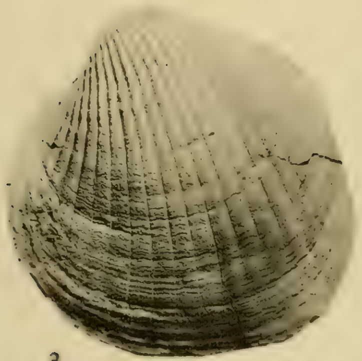

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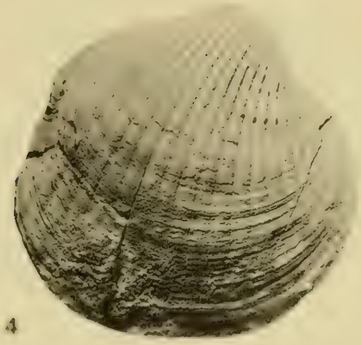

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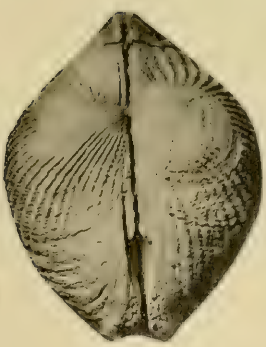

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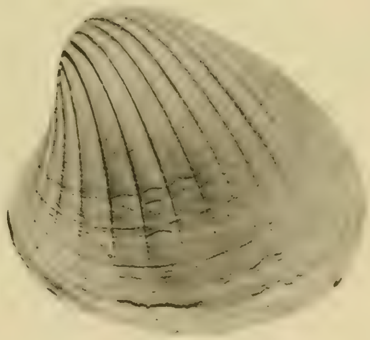

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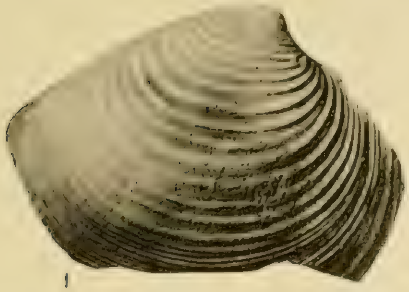
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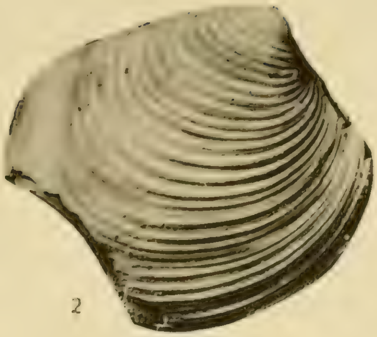
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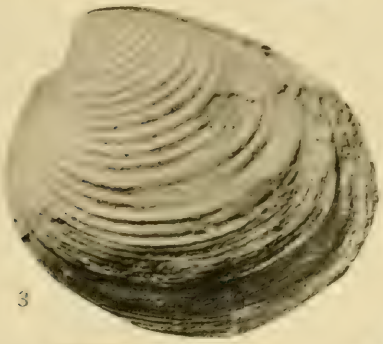
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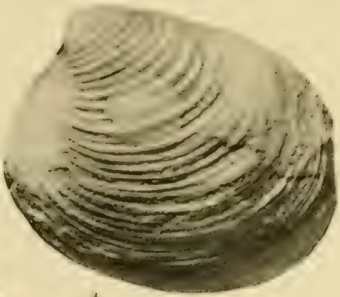
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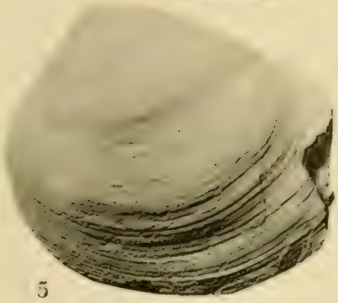
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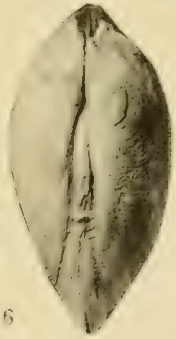
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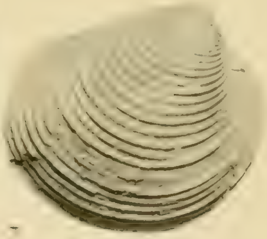
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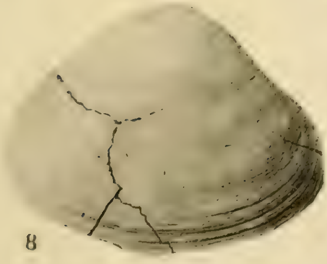
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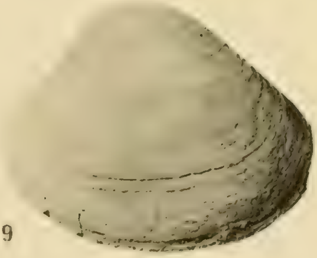
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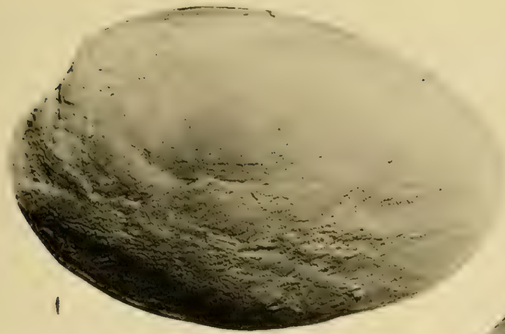
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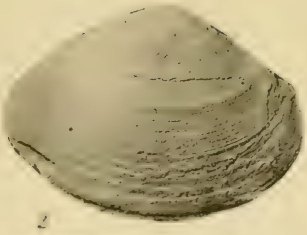
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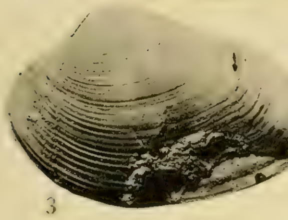
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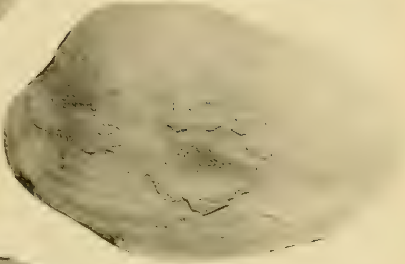
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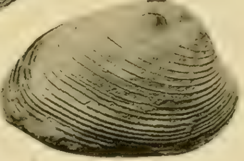
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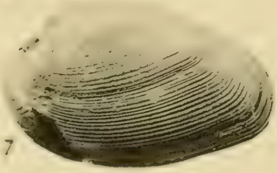
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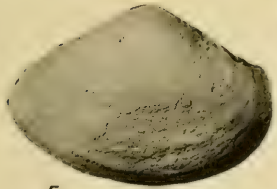
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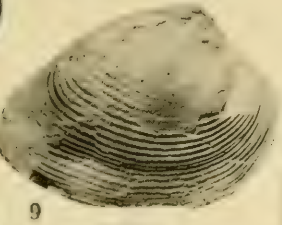
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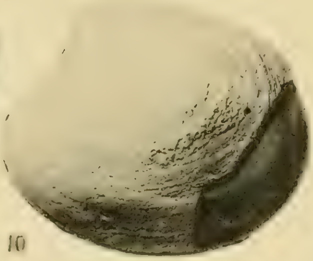
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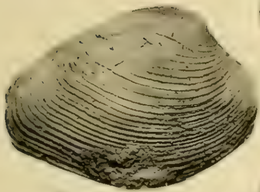
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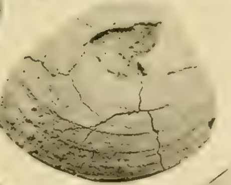
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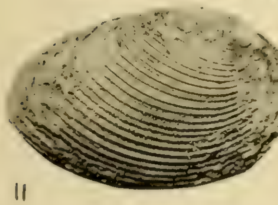
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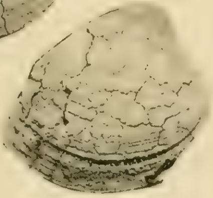
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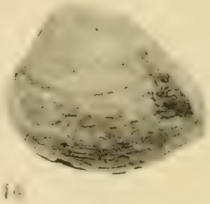
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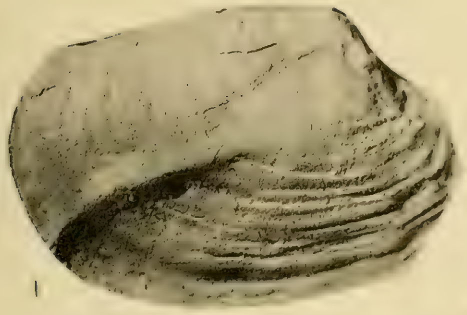
9.	**Diplodonta? dissona** n. sp. Cotype, length 21mm. Salina formation, Negritos	30



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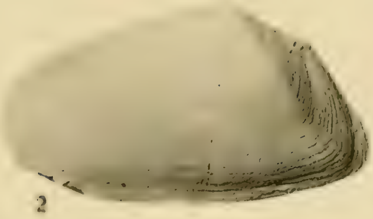

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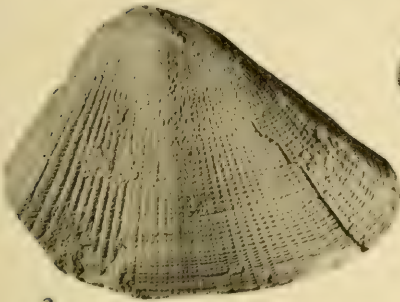

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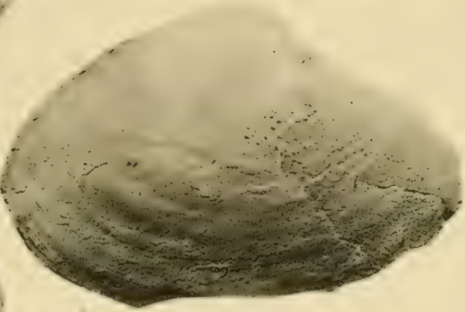

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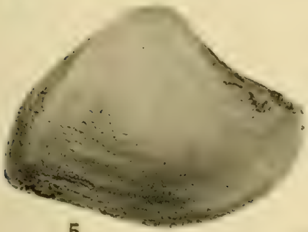

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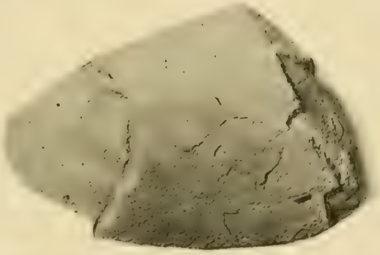

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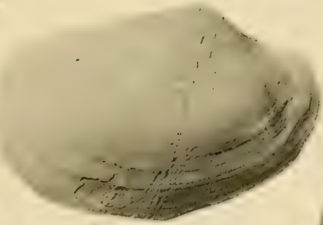

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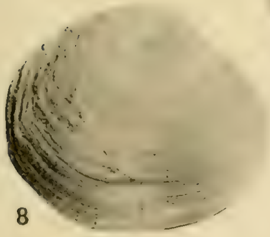

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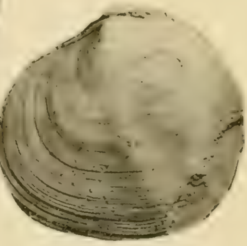

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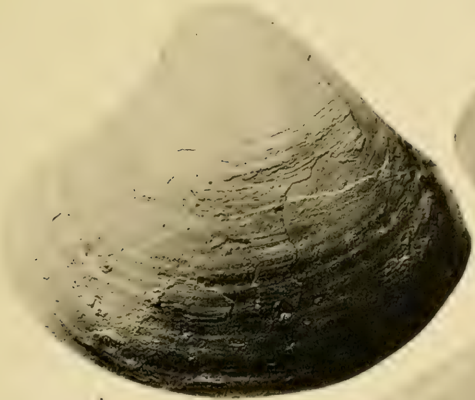

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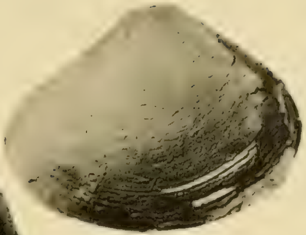

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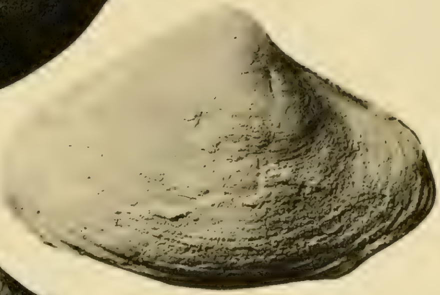

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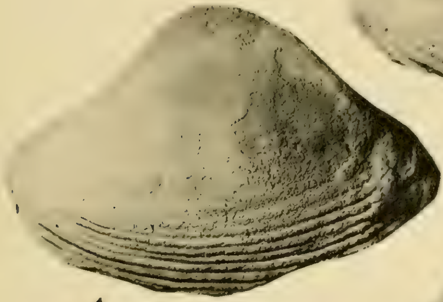

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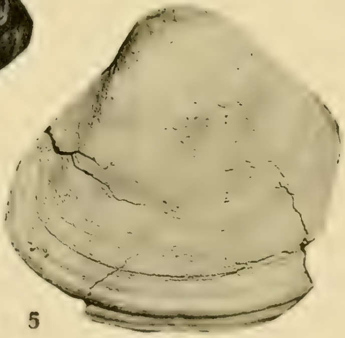

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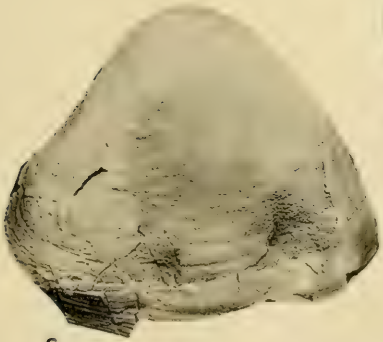

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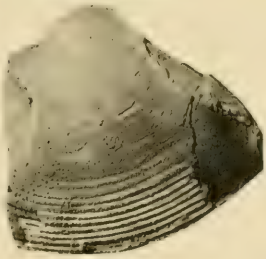

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17. **Corbula salina** n. sp. 51
Cotype, length 7.5mm.
Saman formation, Negritos

18. **Corbula boggsi** n. sp. 50
Holotype, length 8mm.
Saman formation, Negritos

19. **Corbula boggsi** n. sp. 50
Cotype, length 8mm.
Saman formation, Negritos

20. **Corbula boggsi** n. sp. 50
Cotype, length 8mm.
Saman formation, Negritos

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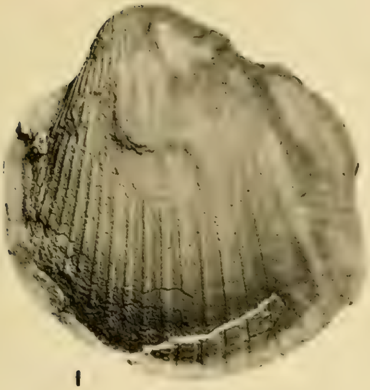
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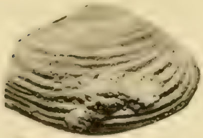
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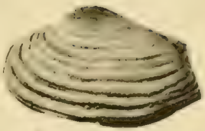
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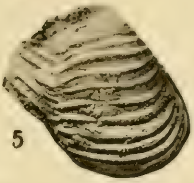
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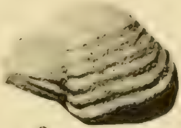
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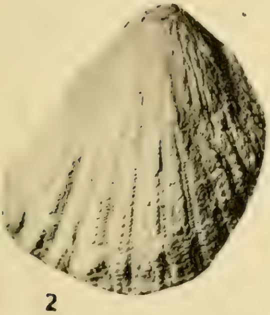
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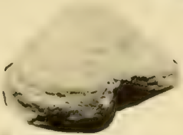
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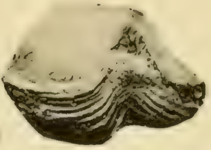
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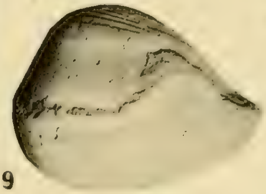
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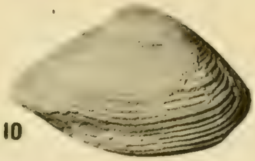
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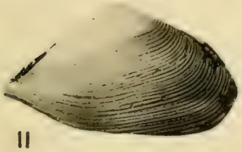
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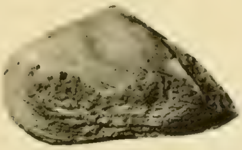
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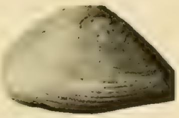
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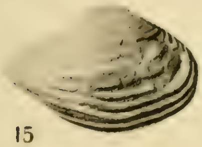
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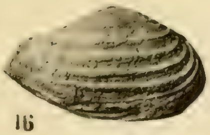
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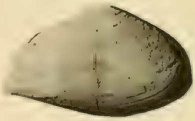
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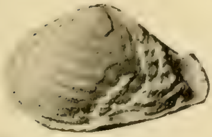
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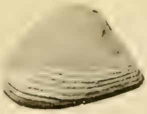
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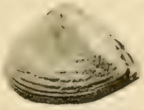
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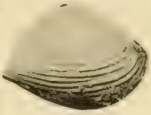
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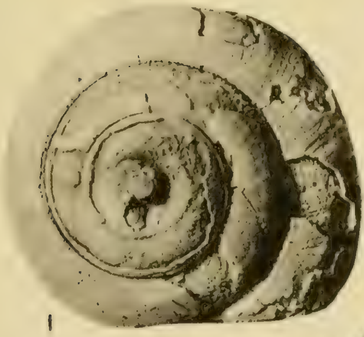
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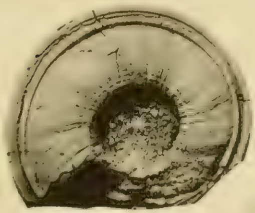
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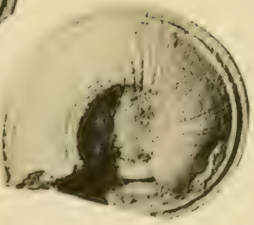
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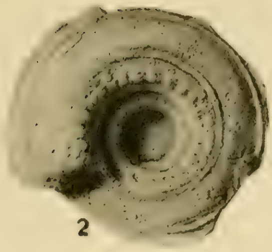
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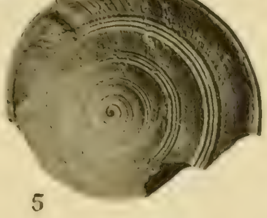
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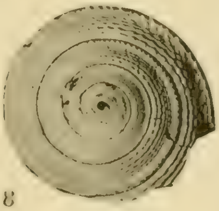
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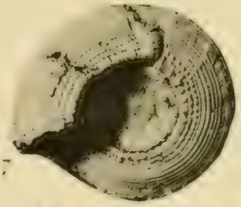
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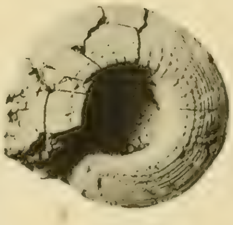
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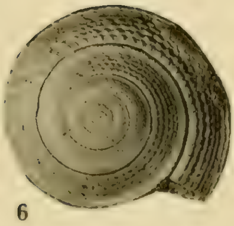
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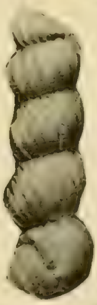
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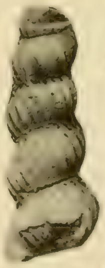
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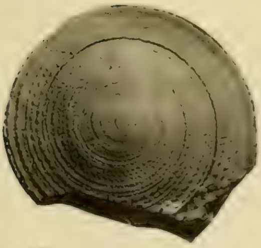
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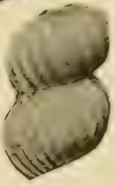
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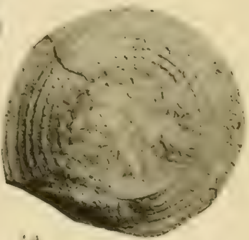
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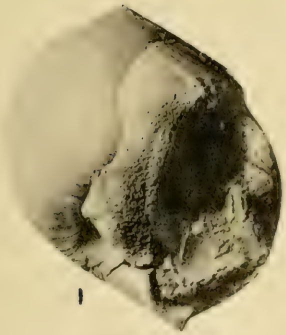
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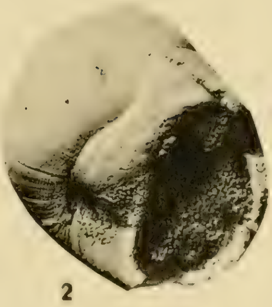
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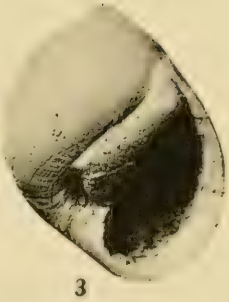
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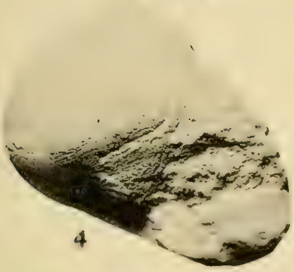
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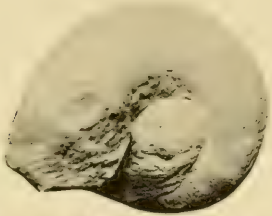
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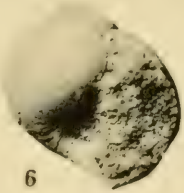
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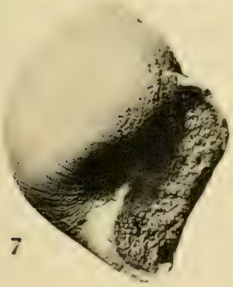
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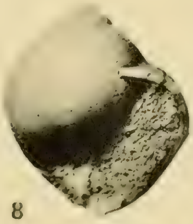
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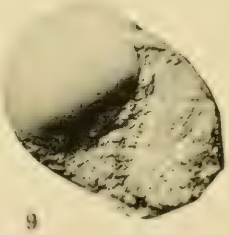
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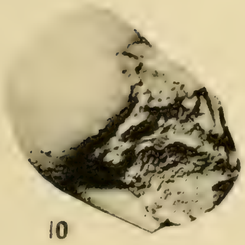
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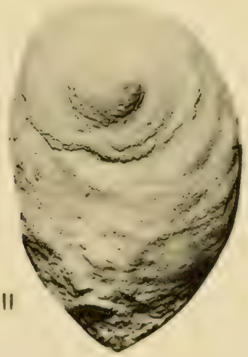
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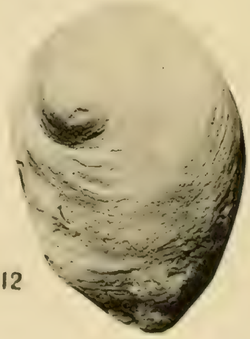
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Explanation of Plate 14

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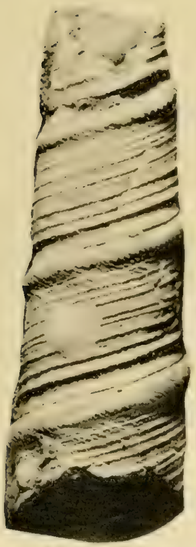
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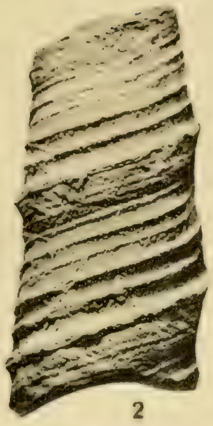
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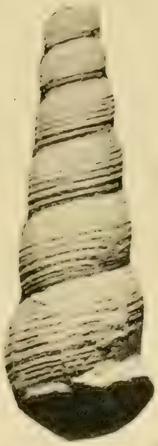
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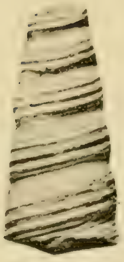
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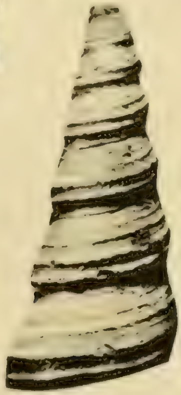
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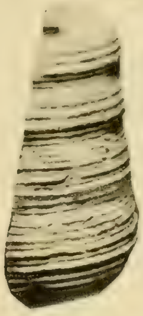
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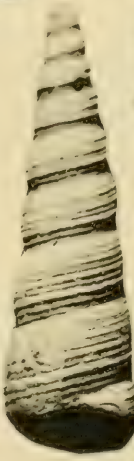
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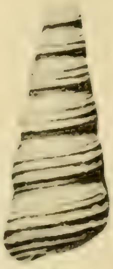
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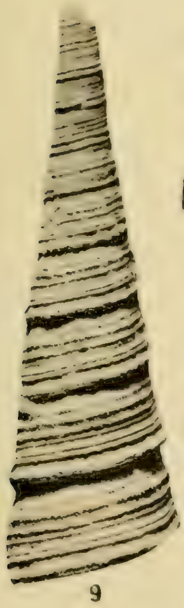
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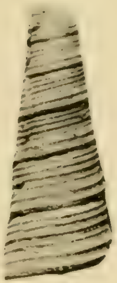
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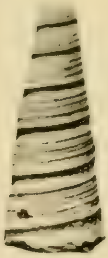
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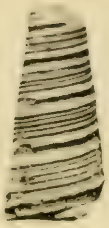
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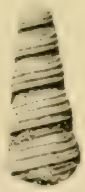
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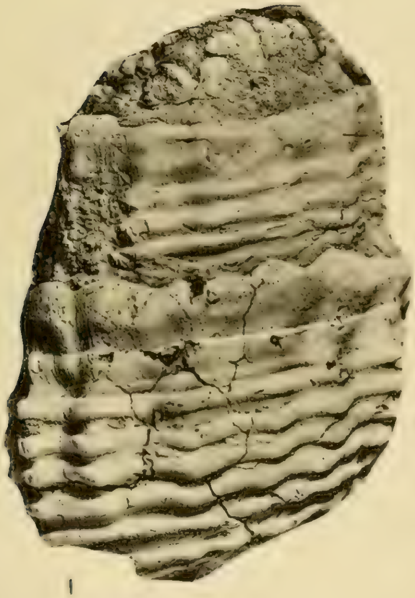
Explanation of Plate 15

Figure Page

1. **Cerithium boweni** n. sp. 69
   Holotype, diameter 54mm.
   Pale Greda formation, Restin
2. **Telescopium? samanense** n. sp. 71
   Cotype, fragmentary specimen, diameter 28mm.
   Saman formation, Lagunitas sandstones, Lagunitas
3. **Telescopium? samanense** n. sp. 71
   Holotype, diameter 33, length 68
   Saman formation, Saman ss, Casa Saman
4. **Cerithium iddingsi** n. sp. 68
   Holotype, length 91mm.
   Pale Greda formation, Negritos



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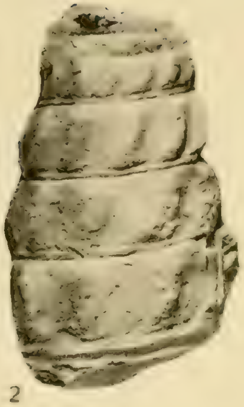

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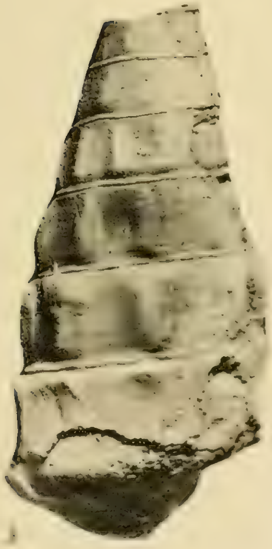

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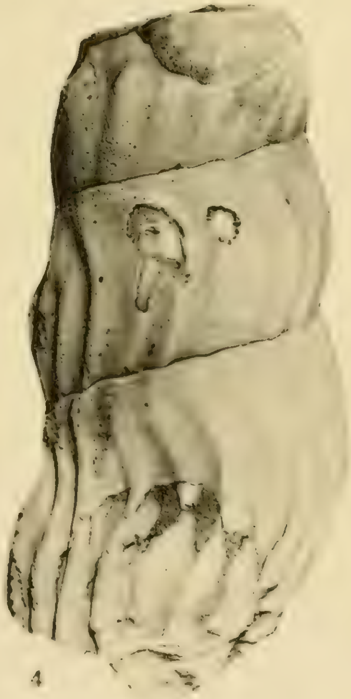

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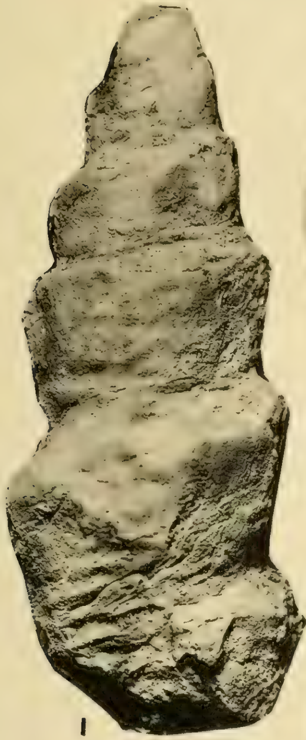
Explanation of Plate 16

Figure Page

1. **Cerithium hopkinsi** n. sp. 68
Holotype, length 134mm.
Restin formation, Que. Botija
2. **Cypræa boggsi n. sp.** 74
Holotype, length or greater diameter 36mm.
Saman formation, Saman congl., near Negritos.
3. **Ectinochilus gaudichaudi** var. **alauda** n. var. 71
Holotype, length 21mm.
Saman formation, Saman congl., near Negritos.
4. **Ectinochilus gaudichaudi** var. **aluda** n. var. 71
Cotype, length 20mm.
Saman formation, Saman congl., near Negritos.
5. **Ectinochilus gaudichaudi** d'Orbigny 71
Type form, length 27mm.
Saman formation, Saman ss. of Casa Saman.
6. **Cerithium xenium** n. sp. 70
Holotype, length 80mm.
Restin formation, Jabonillal.
7. **Ectinochilus gaudichaudi** d'Orbigny 71
Typical form, length 28.5mm.
Samas ss. of Casa Saman.
8. **Voluta (Peruluta) peruviana** var. **samanica** n. var. 91
Apical view showing complete covering of summit with callus,
Diameter 31mm.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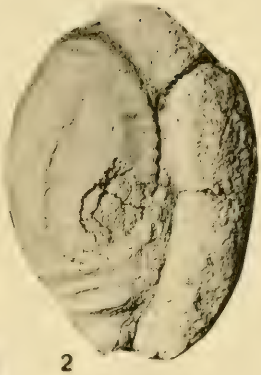
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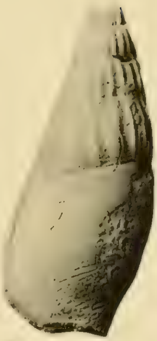
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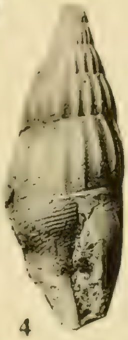
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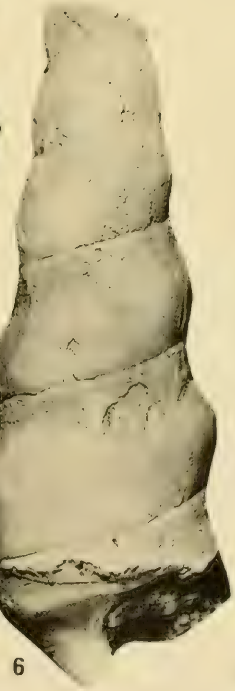
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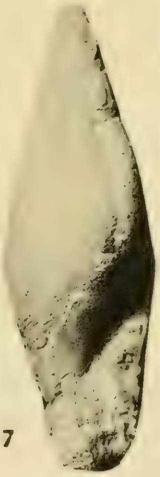
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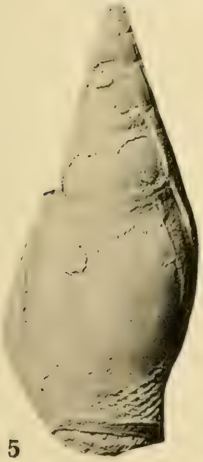
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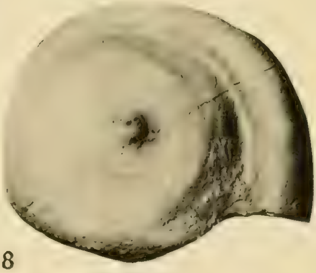
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Explanation of Plate 17

Figure Page

1. **Melongena (Cornulina) levifusoides** n. sp. 84
Holotype, height 35mm.
Saman formation, Casa Saman.

2. **Melongena (Pugilina) œdicnema** n. sp. 85
Holotype, height 39mm.
Saman formation, Casa Saman.

3. **Pyrula otaria** n. sp. 76
Holotype, height of fragmentary specimen 20mm.
Saman formation, Saman congl., near Negritos.

4. **Telescopium parinense** n. sp. 70
Holotype, length of height 39mm.
Parinas formation, Keswick Hills.

5. **Cassidea maccormacki** n. sp. 75
Holotype, ventral view, length 26mm.
Saman formation, Saman congl., near Lagunitas.

6. **Cassidea maccormacki** n. sp. 75
Dorsal view of same specimen.

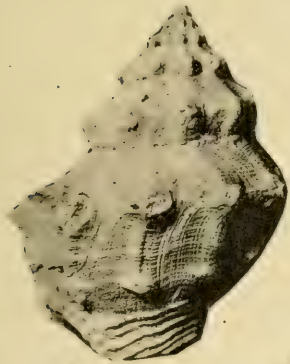
7. **Lyria sabulosa** n. sp. 93
Cotype, fragmentary specimen.
Saman congl., near Negritos.

8. **Lyria sabulosa** n. sp. 93
Holotype, length or height 37mm.
Saman formation, Saman congl., near Negritos.

9. **Sconsia? samanica** n. sp. 76
Holotype, dorsal view, height 28.5mm.
Saman formation, Saman congl., near Negritos.

10. **Sconsia? samanica** n. sp. 76
Holotype, ventral view, height 28.5mm.
Saman formation, Negritos.

11. **Tritonidea staufti** n. sp. 82
Holotype, height 28mm.
Saman formation, Casa Saman.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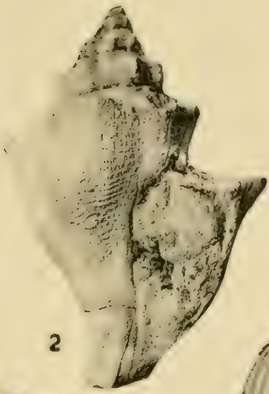
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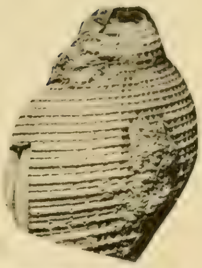
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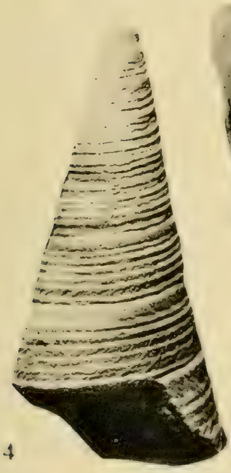
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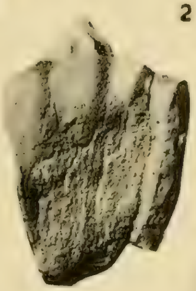
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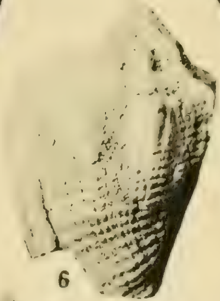
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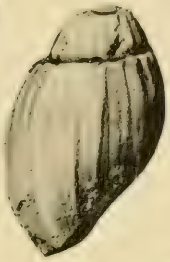
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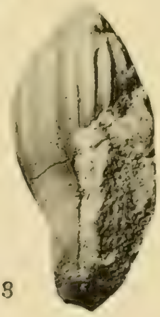
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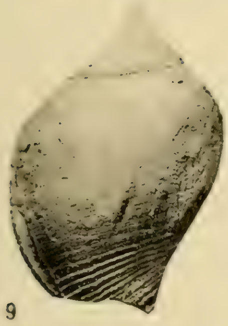
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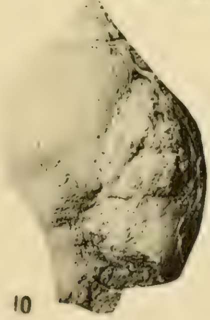
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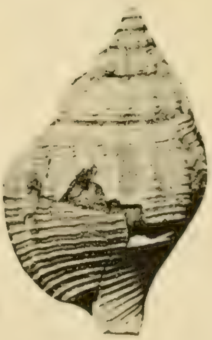
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Explanation of Plate 18

Figure		Page
1.	**Calyptraphorus (Aulacodiscus) lissoni** H. Douvillé Ventral view, greater diameter 30mm. Negritos formation, Negritos.	73
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3	**Calyptraphorus (Aulacodiscus)** lissoni H. Douvillé Dorsal view of same specimen as fig. 1.	73
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12.	**Olivella vicana** n. sp. Cotype. Restin formation, Jabonillal.	93
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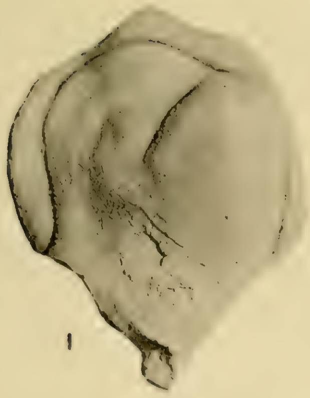
14.	**Alectrion terebratula** n. sp. Holotype. Saman formation, Saman congl., near Negritos.	83
15.	**Alectrion terebratula** n. sp. Cotype. Saman congl., near Negritos.	83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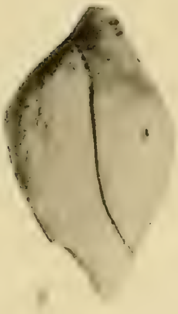
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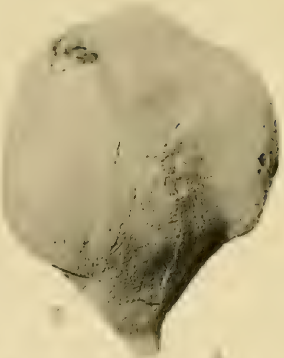
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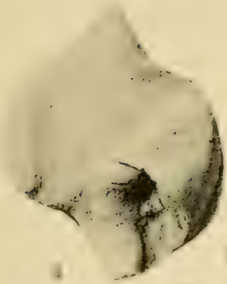
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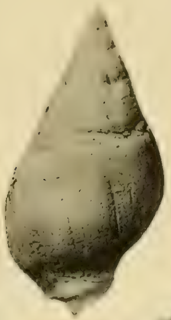
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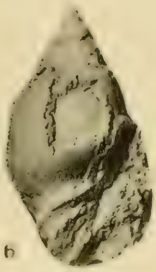
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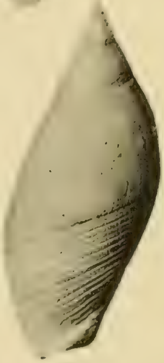
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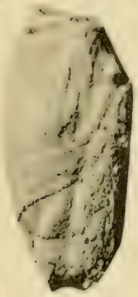
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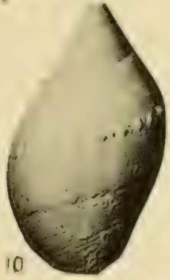
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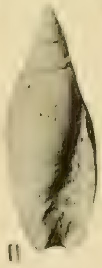
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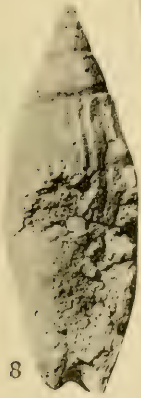
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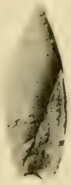
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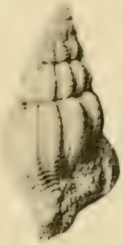
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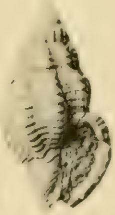
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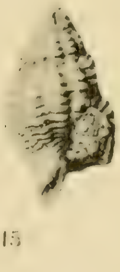
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Explanation of Plate 19

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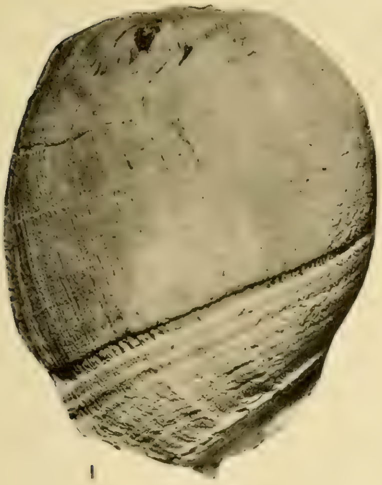
1	**Pseudoliva parinasensis** var. **samanica** n. var. Dorsal view of a large specimen, natural size. Saman formation, Casa Saman.	77
2.	**Pseudoliva parinasensis** var. **samanica** n. var. Holotype, apical view, natural size. Casa Saman.	77
3.	**Pseudoliva parinasensis** var. **samanica** n. var. Holotype, ventral view, natural size. Casa Saman.	77
4.	**Pseudoliva parinasensis** var. **mancorensis** n. var. Holotype, dorsal view, natural size. Mancora formation, Que. Charinal.	78
5.	**Pseudoliva parinasensis** var. **mancorensis** n. var. Cotype, apical view, natural size. Mancora formation, Que. Charanal.	78
6.	**Pseudoliva parinasensis** var. **mancorensis** n. var. Cotype, ventral view, natural size. Mancora formation, Que. Charanal.	78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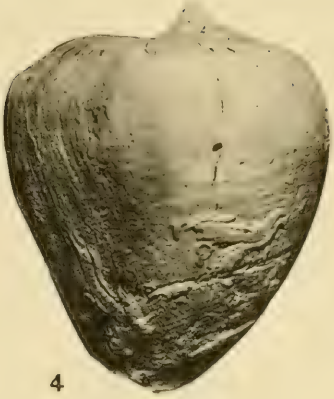
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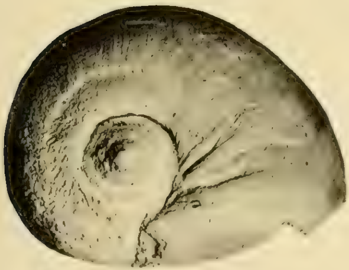
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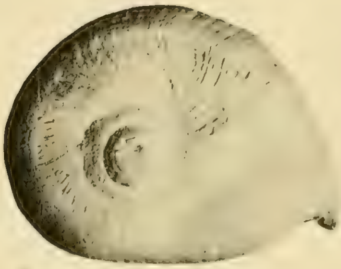
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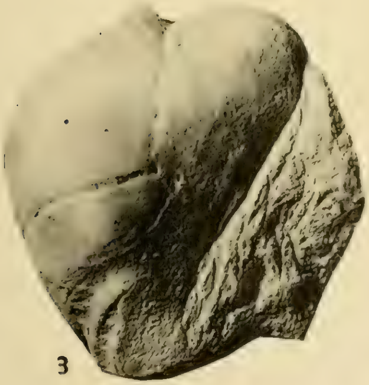
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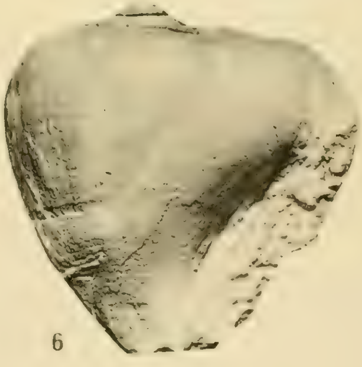
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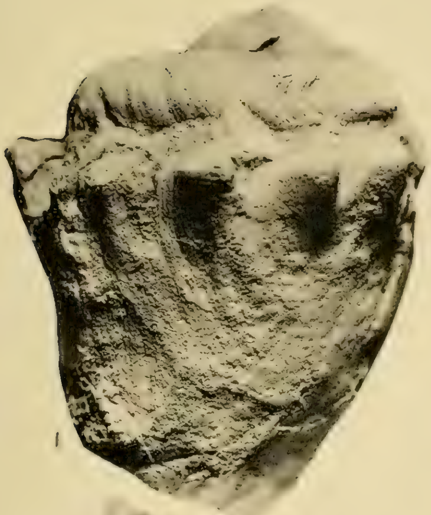
Explanation of Plate 20

Figure		Page
1.	**Pseudoliva mutabilis** var. **douvilléi** n. var. Holotype, about natural size. Restin formation, Pozo Valley on east side of Keswick Hills.	81
2.	**Haminea solaria** n. sp. Holotype, diameter 59mm. Restin formation, Balcones Point.	95
3.	**Ovula negritensis** n. sp. Holotype, height 37mm. Saman formation, Saman congl., near Negritos.	74
4.	**Haminea solaria** n. sp. Apical view of holotype, diameter 59mm.	95
5.	**Pseudoliva mutabilis** var. **woodsi** n. var. Dorsal view of holotype, about natural size. Salina formation, Negritos.	80
6.	**Haminea labrea** n. sp. Ventral view of holotype, diameter 34mm. Negritos formation, La Brea.	95



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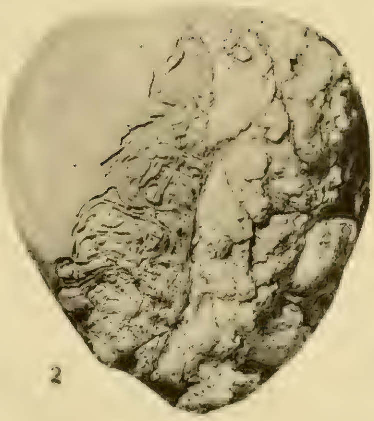

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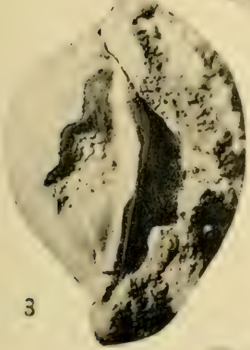

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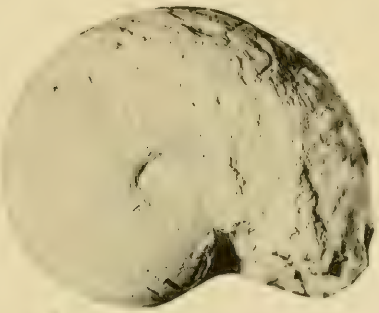

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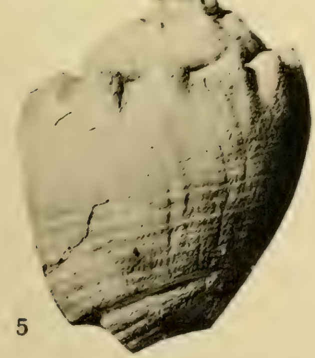

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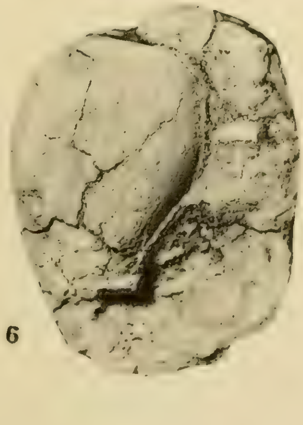

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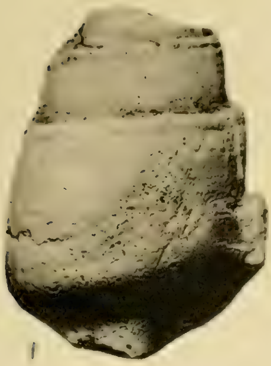
Explanation of Plate 21

Figure Page

1. **Clavilithes woodringi** n. sp. 87
   Holotype, height 42mm.
   Saman congl., near Lagunitas.
2. **Clavilithes woodringi** n. sp. 87
   Cotype, height 34.5mm.
   Saman congl., near Lagunitas.
3. **Clavilithes woodringi** n. sp. 87
   Cotype, height 43mm.
   Near Lagunitas.
4. **Clavilithes lagunitensis** n. sp. 88
   Cotype, height 53mm.
   Saman congl., near Lagunitas.
5. **Xancus peruvianus** n. sp. 89
   Holotype, height 85mm.
   Chira shales, near Casa Saman.
6. **Clavilithes Pozœnsis** n. sp. 86
   Cotype, height of fragmentary specimen 31mm.
   Saman congl., Lagunitas.
7. **Clavilithes lagunitensis** n. sp. 88
   Holotype, height 42mm.
   Saman congl., Lagunitas.
8. **Clavilithes pozœnsis** n. sp. 86
   Holotype, height 40mm.
   Saman congl., Lagunitas.
9. **Clavilithes pozœnsis** n. sp. 86
   Cotype to show the contracted aperture, height 26mm.
   Saman congl., Lagunitas.



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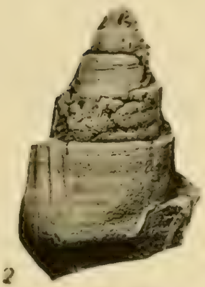

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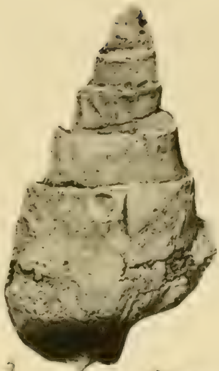

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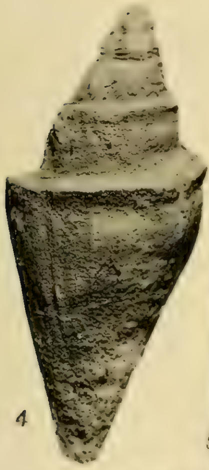

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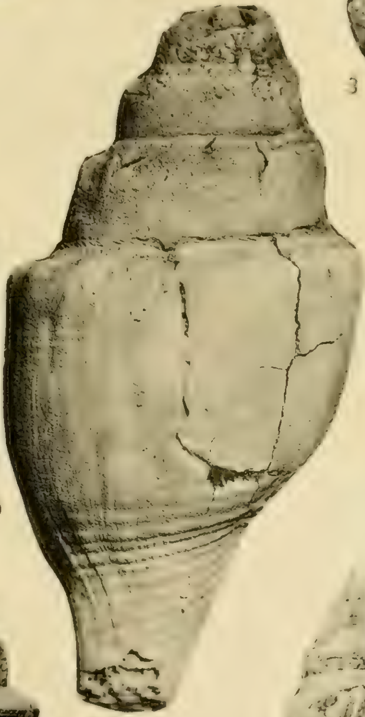

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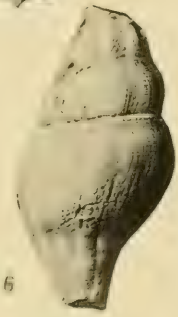

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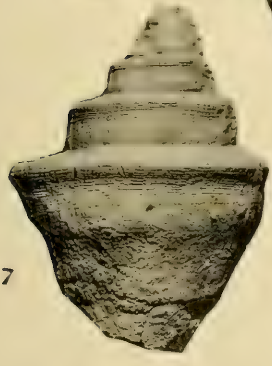

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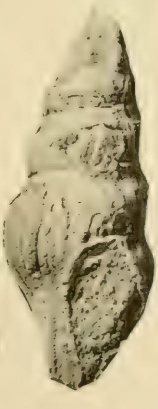

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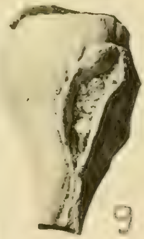

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Explanation of Plate 22

Figure Page

1. **Voluta (Peruluta) mancorensis** n. sp. 92
   Holotype, ventral view, about natural size.
   Saman formation, Casa Saman.
2. **Voluta (Peruluta) mancorensis** n. sp. 92
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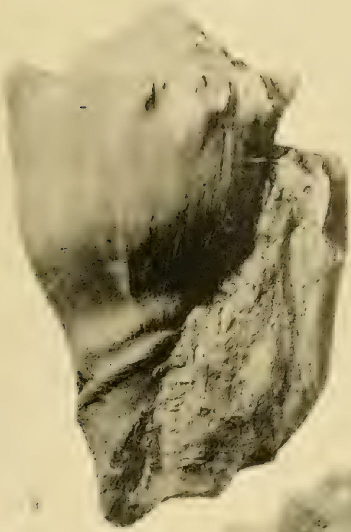
   Casa Saman.
3. **Voluta (Peruluta) mancorensis** n. sp. 92
   Cotype, ventral view showing large columellar folds.
   Casa Saman.
4. **Voluta (Peruluta) peruviana** var.**samanica** n. var. 91
   Cotype, ventral view, about natural size.
   Saman formation, horizon of the Saman congl., near Negritos.
5. **Voluta (Peruluta) peruviana** var. **samanica** n. var. 91
   Holotype, dorsal view, about natural size.
   Saman congl., near Negritos.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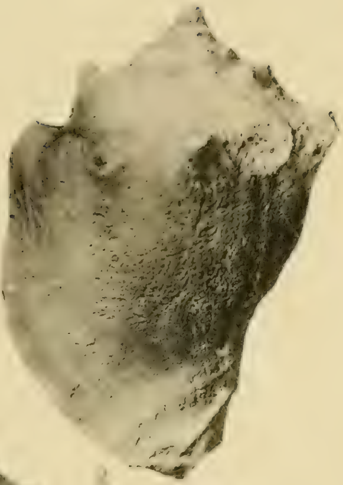
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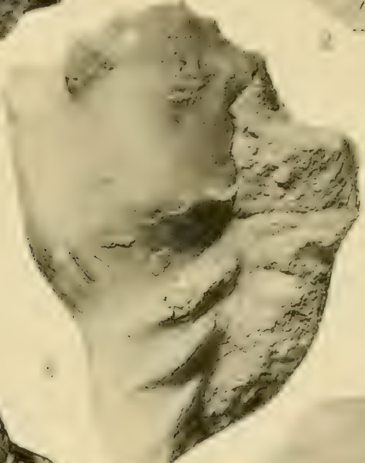
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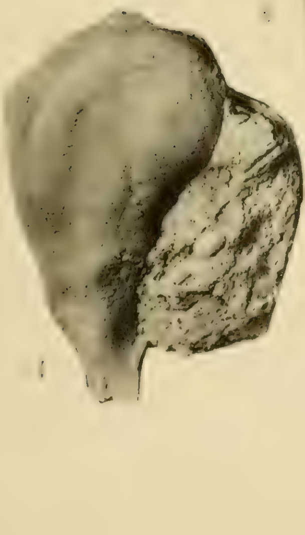
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Explanation of Plate 23

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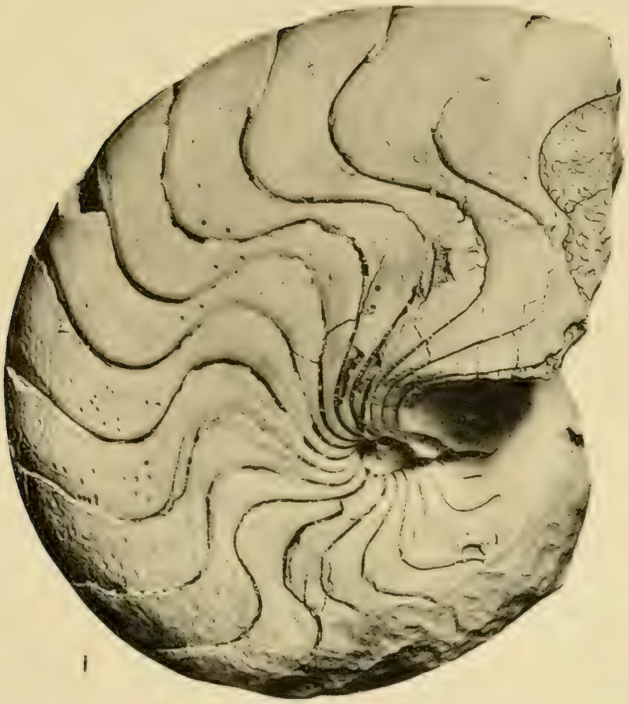
1. **Hercoglossa peruviana** Berry 96
   Topotype, young specimen, height 87mm.
   Restin formation, Lobitos.

2. **Eutrephoceras haughti** n. sp. 101
   Holotype, greater diameter 61mm.
   Saman formation, Lagunitas.



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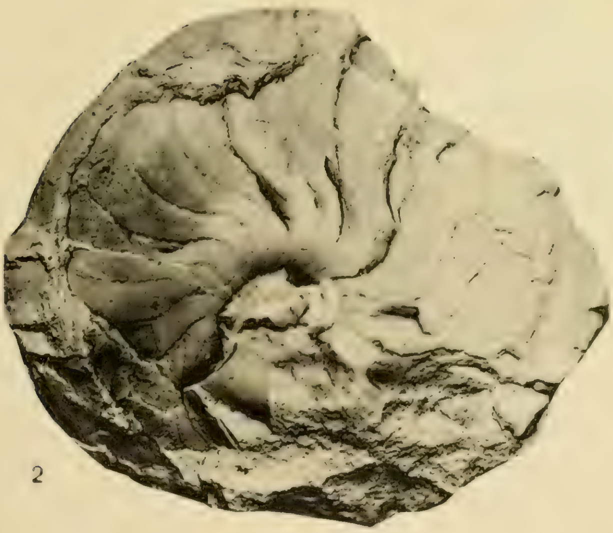

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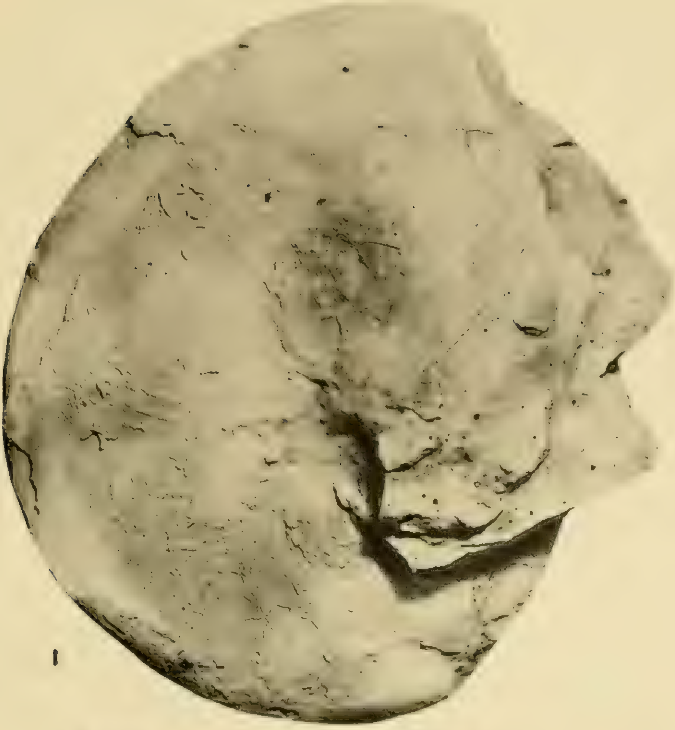
Explanation of Plate 24

1. **Aturia alabamensis** var. **peruviana** n. var. 99
   Holotype, greater diameter 200mm.
   Saman formation, Casa Saman.
2. **Aturia alabamensis** var. **peruviana** n. var. 99
   Heath formation, Cone Hill shales near Tamarindo, Chira valley,
   Height or greater diameter 34 mm.
3. **Aturia alabamensis** var. **peruviana** n. var. 99
   Fragmentary specimen showing the characteristic suture lines.
   About natural size.
   Saman formation, Near Lagunitas.



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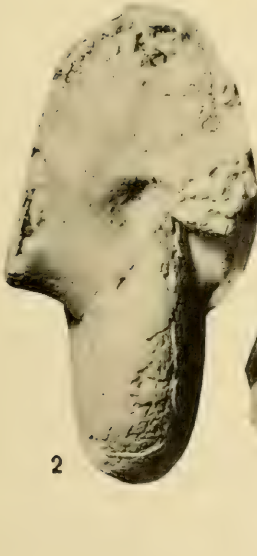

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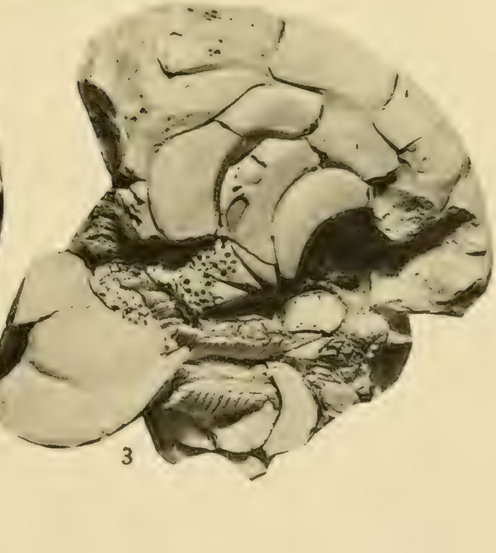

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Explanation of Plate 25

Figure		Page
1.	**Aturia** cf. **zic-zac** Sowerby Greater diameter about 100mm. Salina formation, Negritos	96
2.	**Liothyrina peruviana** n. sp. Holotype, height 25mm. Saman formation, Saman congl., near Lagunitas.	101
3. 4.	**Liothyrina peruviana** n. sp. Cotype, height 24mm. Same locality as last.	101
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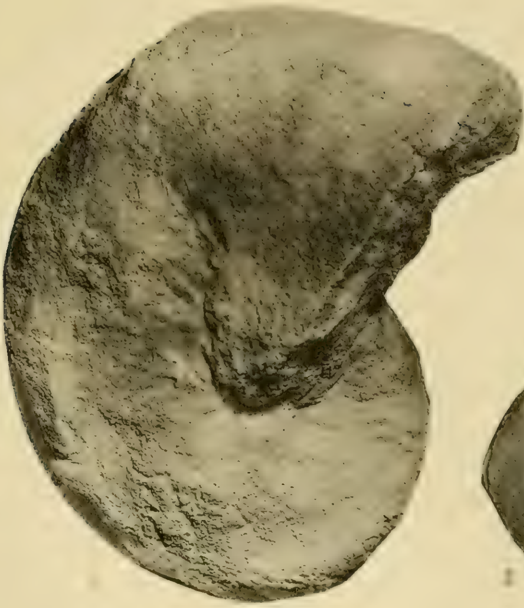
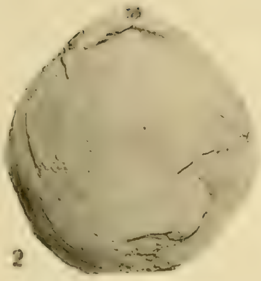
6.	**Aturia** cf. **zic-zac** Sowerby Same specimen as fig. 1.	96





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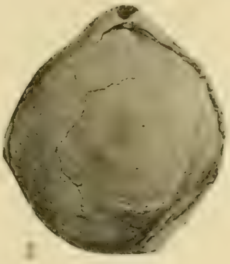

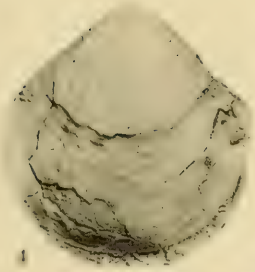

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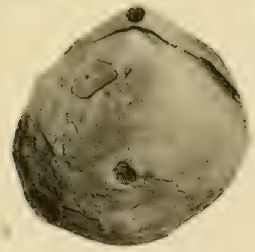

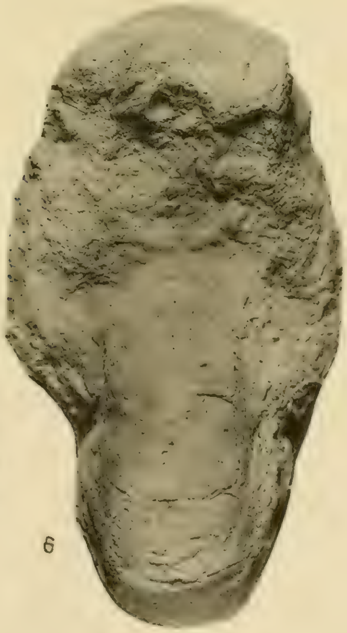

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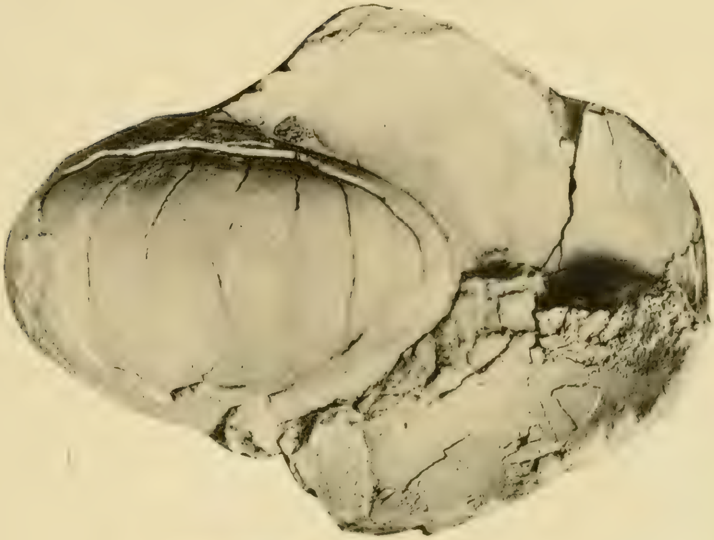
Explanation of Plate 26

1. **Eutrephoceras negritensis** n. sp. 99
   Holotype, greater diameter 86mm.
   Pale Greda formation, near Negritos.
2. **Eutrephoceras negritensis** n. sp. 99
   Holotype, greater diameter 86mm.
   Pale Greda formation, near Negritos.



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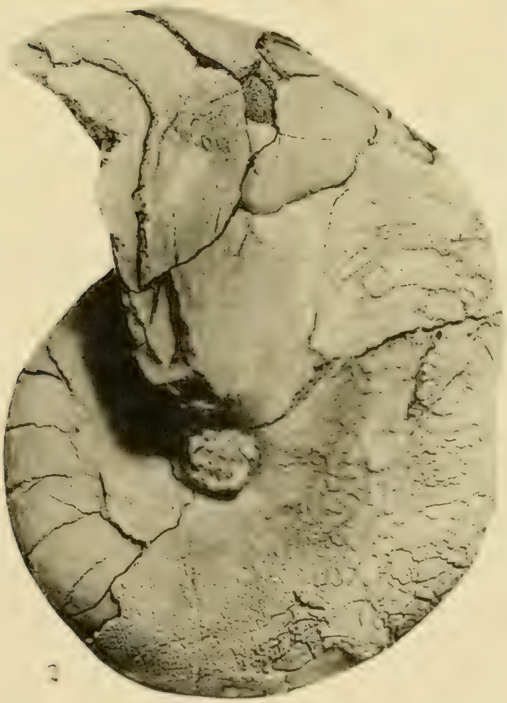

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No. 53

A FORAMINIFERAL FAUNA FROM THE CHAPAPOTE FORMATION IN MEXICO

BY

W. STORRS COLE

April 2, 1928

Harris Co.
Ithaca, N. Y.
U. S. A.

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INTRODUCTION

The Chapapote (1) formation outcrops typically on the Tuxpam river near the village of Chapapote. So far as is known from well-sections and surface samples, the formation is more or less uniform throughout its vertical extent, being composed of grey indurated clays which are very rich in certain pelagic types of foraminifera.

In this paper, it is my endeavor to record most of the important and diagnostic forms. Cushman, in various papers, has described many of the more characteristic ones. But his species, due to the confusion that has existed in the Mexican stratigraphic column, are often listed as typical of certain formations in which they do not occur, or in which they are found only rarely.

The abundance of *Hantkenina alabamensis* Cushman, together with certain other forms, suggests a correlation of the Chapapote with the Upper Eocene (Jackson) of the Gulf States. But to date no Mollusks or other forms have been found in the Chapapote to check the foraminiferal correlation.

As is stated in my discussion of the Guayabal[2], the Chapapote overlies the Guayabal, from which it is easily distinguished lithologically and faunally.

The Chapapote may be separated readily from the overlying Alazan. The Alazan, in the contact zone above the Chapapote, contains numerous species of *Uvigerina,* many of which are as yet un-named. It also contains such forms as *Bulimina sculptil s* Cushman, *Uvigerina byramensis* Cushman, *Vulvulina spinosa* Cushman, *Planulina mexicana* Cushman, *Globorotalia byramensis* (Cushman) and *Plectofrondicularia alazanensis* Cushman. *Pavonina mexicana* Cushman and *Rectobolivina mexicana* (Cushman) also occur in the lower Alazan zone. The contact of the Chapapote and Alazan extends through the Buena Vista river valley very near the type locality of the Alazan. I have personally collected a sample of undoubted Chapapote age a short way down

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[1] W. S. Cole, Bull. Amer. Pal., vol. 14, No. 51, p. 7, 1927.
[2] Idem, p. 7.

stream from the type locality of the Alazan. Mr. Dorr of the Huasteca Petroleum Company has confirmed, by means of well sections, surface samples and the areal geology map, my observations and convictions that the contact of the Alazan and Chapapote formations passes through the Buena Vista river valley.

The Chapapote is equivalent in time to the Tantoyuca[3] and should be considered the deep-water phase[4] of that formation.

The author wishes to acknowledge his indebtedness for various favors and help in connection with the preparation of this paper to Mr. Carroll H. Wegemann, chief geologist of the Pan-American Petroleum and Transport Company, for permission to publish on this material, to Mr. Ellis A. Hall, Mr. John H. Wilson and Mr. James B. Dorr of the Huasteca Petroleum Company for aid in collecting the samples, and also to Mr. Dorr for information as to the stratigraphic position and correlation of the Chapapote with the other Mexican formations.

The samples were examined and this paper was prepared at Cornell University after the writer had resigned from the Huasteca Petroleum Company at Tampico, Mexico, in order to continue his graduate studies in Planeontology.

DESCPRIPTION OF SPECIES

FAMILY SACCAMMINIDÆ

GENUS SACCAMMINA W. B. Carpenter, 1869

Saccammina sphærica G. O. Sars Plate 3, fig. 15

Saccammina sphærica G. O. Sars, Forh. Vid. Selsk. Christiania., p. 248, (nomen nudum) 1868 (1869).
Saccammina sphærica H. B. Brady, Rept. Voy. Challenger, Zoo., vol. 9, p. 253, pl. 18, figs. 11-15, 17, 1884.
Saccammina sphærica Cushman, Bull. U. S. Nat. Mus., No. 71, pt. 1, p. 39, figs. 33-36, 1910.

This species, found in the Chapapote, agrees very closely with recent forms. It is slightly flattened on one side; otherwise identical with the descriptions and figures given. It is very rare in the Chapapote strata and of no value as a stratigraphic marker.

[3] W. S. Cole, Bull. Amer. Pal., vol. 14, No. 51, p. 8, 1927.
[4] Personal communication from Mr. James B. Dorr.

FAMILY REOPHACIDÆ

GENUS REOPHAX Montfort, 1808

Reophax nevini n. sp. Plate 3, fig. 9

Test short, compressed, tapering, consisting of 3-5 chambers, each larger than the preceding one; wall thick, composed of large sand grains, rather rough on the exterior, generally pure white in color; sutures but slightly depressed, more strongly depressed between the last formed chambers; aperture slightly produced.

Length 2.3 mm.

This species is near the recent *R. compressus* Goes, but differs in being less compressed with the sides more tapering. It is named in honor of Dr. C. M. Nevin, Assistant Professor of Structural Geology at Cornell University.

FAMILY AMMODISCIDÆ

GENUS AMMODISCUS Reuss, 1861

Ammodiscus incertus (d'Orbigny)

Operculina incerta d'Orbigny, Foram. Cuba, p. 71, pl. 6, figs. 16, 17, 1839.
Ammodiscus incertus H. B. Brady, Rept. Voy. Challenger, Zoo., vol. 9, p. 330, pl. 38, figs. 1-3, 1884.
Ammodiscus incertus Plummer, Bull. Univ. Texas, No. 2644, pp. 63-64, figs. 1a-d, 1926.
Ammodiscus incertus Cole, Bull. Amer. Pal., vol. 14, No. 51, pp. 10-11, pl. 4, fig. 17, 1927.

This is one of the long ranged Eocene foraminifera in Mexico. It is fairly common in the Chapapote samples, but occurs only rarely in the Guayabal samples. Both the laterally compressed and perfect forms are found in the Chapapote.

FAMILY LITUOLIDÆ

GENUS HAPLOPHRAGMOIDES Cushman, 1910

Haplophragmoides chapapotensis n. sp. Plate 2, fig. 1

Test comparatively small, coarsely arenaceous, surface rough, close coiled, planospiral, involute, very slightly umbilicate, last formed coil composed of about eight chambers; sutures very indistinct, but the final two generally depressed; periphery broadly rounded; aperture simple at the base of the last formed chamber.

Diameter 0.57 mm.

This species is very near *H. coalingensis* Cushman and Hanna, but differs in that it has a smaller number of chambers and much rougher finish. It occurs only in the Chapapote according to my studies and determinations.

FAMILY TEXTULARIIDÆ

GENUS TEXTULARIA Defrance, 1824

Textularia chapapotensis n. sp. Plate 2, fig. 9

Test relatively large, stout, about twice as long as wide; periphery broadly rounded, sutures very slightly depressed, but generally distinct; chambers large, few in number; wall very finely arenaceous with much cement, giving it a very smooth finish; aperture rather large, distinct.

Length 1 mm.

This is a characteristic species which seems to be confined to the Chapapote. Unfortunately, it is rare at all horizons.

Textularia eocæna (Gumbel) Plate 3, fig. 7

Plecanium eocœnum Gumbel, Abh. K. Bay. Akad. Wiss., vol. 10, p. 603, pl. 1, figs. 3, bis, a, b, 1868.
Textularia eocæna Plummer, Bull. Univ. Texas., No. 2664, p. 67, pl. 3, figs. 2a, b, 1926.

There are species in the Chapapote which resemble both Gumbel's and Mrs. Plummer's figures and descriptions. It is rare at all horizons, but easily recognized on account of its large size when present. This species is confined to the Chapapote.

GENUS VULVULINA d'Orbigny, 1826

Vulvulina advena Cushman Plate 3, fig. 17; Plate 1, fig. 24

Vulvulina advena Cushman, Cont. Cush. Lab. Foram. Res., vol. 2, pt. 2, p. 32, pl. 4, figs. 9a, b, 1926.
Vulvulina cf. V. spinosa Cole, Bull. Amer. Pal., vol. 14, No. 51, p. 12, pl. 1, fig. 12, 1927.

Throughout the Chapapote, this form, described by Cushman from the Upper Eocene of Alabama, is commonly present although it is never abundant. It is distinct from *V. spinosa* of the Alazan because it lacks the spinosity of that form.

FAMILY VERNEUILINIDÆ

GENUS TRITAXILINA Cushman, 1911

Tritaxilina mexicana Cushman Plate 1, figs. 21, 22

Tritaxilina mexicana Cushman, Cont. Cush. Lab. Foram. Res., vol. 1, pt. 3, p. 64, pl. 10, fig. 4, 1925.

Most of the specimens found in the sample from the type locality of the Chapapote appear to be young forms in which the uniserial portion with its terminal mouth has not developed. The adult specimen which I am figuring came from the well, Cerro Azul No. 75 at the depth of 370′. This species, particularly young specimens, is a rare but constant species throughout the Chapapote.

GENUS CLAVULINA d'Orbigny, 1826

Clavulina communis d'Orbigny Plate 2, figs. 2, 3

Clavulina communis d'Orbigny Ann. Sci. Nat., vol. 7, p. 268, No. 4, 1826.
Clavulina communis d'Orbigny, Foram. Foss. Bass. Tert. Vienne., p. 196, pl. 12, figs. 1, 2, 1846.

There are found in the Chapapote strata, numerous *Clavulina* forms that resemble *C. communis* very closely. For the present, I am placing my forms under this species noting, however, that the maximum length reached, is only slightly over 1 millimeter and that the test is often rather roughly arenaceous. The Chapapote specimens agree more closely with d'Orbigny's figure in his Vienne Foraminifera, than to those generally given of recent specimens referred to this species.

FAMILY MILIOLIDÆ

GENUS TRILOCULINA d'Orbigny, 1826

Triloculina gibba d'Orbigny Plate 1, figs. 7, 8

Triloculina gibba d'Orbigny, Foram. Foss. Bass. Tert. Vienne, p. 274, pl. 16, figs. 22-24, 1846.
Triloculina gibba Hantken, Mitth. Jahrb. ungar. geol. Anstalt., p. 21, pl. 12, fig. 10, 1875.

I am placing under this species with some hesitancy, a form found in the Chapapote. It is very close to d'Orbigny's species.

FAMILY LAGENIDÆ

GENUS LENTICULINA Lamarck, 1804

Lenticulina chapapotensis n. sp. Plate 1, figs. 14, 15

Test tightly coiled, slightly compressed, about three inflated chambers in the final volution, the last comprising nearly half of the test; a very narrow keel extending from the aperture to the bottom of the last septal face; aperture produced, radiate.

Length 0.9 mm. Width 0.63 mm.

This is a very distinct species apparently confined to the Chapapote. In some respects, it resembles *L. beali* (Cushman) from the Miocene of California, but it can be differentiated because of its lack of the angulated sutures and more tightly coiled test.

Lenticulina convergens (Bornemann) Plate 1, figs. 4, 5

Cristellaria convergens Bornemann, Zeitschi. deutsch. geol. Gesel., vol. 7, p. 327, pl. 13, figs. 16, 17, 1855.

Cristellaria convergens Cushman, Jour. of Pal., vol. 1, No. 2, p. 152, pl. 23, fig. 12, 1927.

This form, which is quite like the species described by Bornemann, occurs very infrequently in the Chapapote. The Alazan forms seem more typical, but the Chapapote specimens are very close and should be referred to the same species. Because of its long range, it is valueless as a stratigraphic marker.

GENUS NODOSARIA Lamarck, 1812

Nodosaria jacksonensis Cushman and Applin Plate 3, fig. 12

Nodosaria jacksonensis Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, p. 170, pl. 7, figs. 14-16, 1926.

Specimens that agree very closely to the species described by Cushman and Applin are found occasionally. This is evidently a wide spread and comparatively long ranged species. While *N. harrisi* of the Guayabal is close to this species, the two can be readily recognized as *N. jacksonensis* is much larger, has the sutures between the chambers more constricted and the initial chambers are slightly different.

Nodosaria sp. Plate 3, fig. 11

I am figuring this specimen for future reference. There are numerous fragments of this form at some horizons of the Chapapote, but I was unable to secure a perfect specimen.

GENUS ROBULUS Montfort, 1808

Robulus plummeræ n. sp. Plate 3, fig. 10

Test closely coiled, the length slightly more than the width, strongly keeled, the last formed whorl composed of five chambers; sutures wide, clear, limbate, very gently curved, flush with the surface and joining at the center to give a very slight suggestion of a knob; aperture radiate above, produced as a slit on the last septal face.

Length 1.32 mm. Width 1.09 mm.

This species is named in honor of Mrs. Helen J. Plummer.

GENUS HEMICRISTELLARIA Stache, 1864

Hemicristellaria scitula (Berthelin) Plate 1, fig. 1

Cristellaria scitula Berthelin, Mem. Soc. Geol. de France, ser. 3, No. 1, p. 54, pl. 3, fig. 3, 1880.

Cristellaria scitula Plummer, Bull. Univ. Texas, No. 2644, p. 100, pl. 7, fig. 5, 1926.

This is a very rare species in the Chapapote. I have in my possession only a few specimens for comparison. The Chapapote specimens are very close to both the type of Berthelin and to the one figured by Mrs. Plummer. The chambers of the uncoiling portion are very slightly different in shape. I do not consider the differences strong enough to make this a good variety.

GENUS FISSURINA Reuss, 1850

Fissurina romettensis Saguenza Plate 3, fig. 14

Fissurina romettensis Seguenza, Foram. Monotal. Miocene. Messina, p. 70, pl. 2, fig. 42, 1862.

Fissurina romettensis Galloway and Wissler, Jour. of Pal., vol. 1, No. 1, p. 52, pl. 9, fig. 2, 1927.

Occasionally, specimens are found in the Chapapote which may be referred to this species. Unfortunately, the original figure was not at hand and the determination has been made on Galloway and Wissler's description and figures. The only apparent difference is in size; the average of the Chapapote specimens being about 0.58mm. in diameter.

GENUS LAGENA Walker and Jacob, 1798

Lagena sesquistriata Bagg Plate 2, fig. 8

Lagena sesquistriata Bagg, Bull. U. S. Geol. Survey, No. 513, p. 50, pl. 13, figs. 12-14a, b, 1912.

A form that seems very similar to the one described by Bagg from the Pliocene of California occurs very rarely in the Chapapote. It does not seem to be of any value as a horizon marker on account of its rarity and eccentricity of occurrence.

FAMILY POLYMORPHINIDÆ

GENUS POLYMORPHINA d'Orbigny, 1826

Polymorphina spathulata Terquem Plate 1, fig. 9

Polymorphina spathulata Terquem, Mem. Soc. Geol. de France, ser. 3, vol. 2, p. 142, pl. 14 (22), fig. 32, 1882.
Polymorphina spathulata Plummer, Bull. Univ. Texas. No. 2644, p. 124, pl. 6, figs. 11a-c, 1926.

A form that seems to be within the variation allowed for this species occurs very infrequently in the Chapapote. For the present, I am referring my specimens to this species.

GENUS DIMORPHINA d'Orbigny, 1826

Dimorphina chapapotensis n. sp. Plate 2, fig. 4

Test elongate, cylindrical; uniserial portion composed of about two chambers, sutures strongly depressed, especially toward the apertural end; wall coarsely granular; aperture produced.

Length 0.60 mm.

FAMILY NONIONIDÆ

GENUS NONION Montfort, 1808

Nonion chapapotensis n. sp. Plate 1, figs. 18, 19

Test nearly circular in outline, the periphery broadly rounded; chambers numerous, about eleven in the last formed coil; distinctly umbonate; sutures distinct, limbate, flush with the surface except between the final chambers where they are often slightly depressed; wall smooth, glistening; aperture a low arched slit at the base of the last formed chamber.

Diameter 0.46 mm.

Occasionaly, this species shows more chambers on one side than on the other. At first, I thought it should be placed under the Genus *Anomalina,* but after studying a considerable number of specimens, I have placed it under *Nonion.* These specimens are very close to specimens usually referred to *N. depressula,* but I am of the conviction that it should be made a separate form because the chambers are not inflated to give a lobate appearance to the test and the umbilical filling with its stellate extensions is entirely wanting.

Nonion micrus Cole

Nonion micrus Cole, Bull. Amer. Pal., vol. 14, No. 51, p. 22, pl. 5, fig. 12, 1927.

This small species, described from the Guayabal, ranges into the Chapapote where it is abundant at some horizons. There seems to be no variation in form between the Guayabal and Chapapote specimens. It makes an excellent horizon marker on account of its varying abundance.

FAMILY HETEROHELICIDÆ

GENUS SPIROPLECTOIDES Cushman, 1926

Spiroplectoides annectens (Parker and Jones)

Textularia annectens Parker and Jones, Ann. and Mag. Nat. Hist., ser. 3, vol. 11, p. 92, fig. 1, 1863.

Spiroplecta annectens H. B. Brady, Rept. Voy. Challenger Zoo., vol. 9, p. 376, pl. 45, figs. 22, 23a, b, 1884.

Specimens that agree very closely with this species, occur infrequently in the Chapapote. I am placing my specimens under this species until opportunity is had to make direct comparison with the type material.

FAMILY HANTKENINIDÆ

GENUS HANTKENINA[5] Cushman, 1924

Hantkenina alabamensis Cushman

Hantkenina alabamensis Cushman, Proc. U. S. Nat. Mus., vol. 66, art. 30, p. 3, pl. 1, figs. 1-6, pl. 2, fig. 5, 1924.

Hantkenina alabamensis Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, pp. 177, 178, pl. 10, fig. 3, 1926.

Hantkenina alabamensis Cushman, Cont. Cush. Lab. Foram. Res., vol. 1, pt. 1, p. 7, pl. 1, fig. 11, 1925.

Hantkenina alabamensis Cushman, Cont. Cush. Lab. Foram. Res., vol. 1, pt. 3, p. 68, 1925.

This species is abundant in the sample from the type locality of the Chapapote and is the index fossil of this formation. It can be distinguished readily from *H. brevispina* by its more compressed form and larger spines. It is abundant throughout its range in the Chapapote and is very constant in its characters. Cushman has found this form in the Upper Eocene (Jackson) of Texas and Louisiana. It seems to be restricted to beds of Jackson age both in the United States and Mexico. This species does not range into the Alazan which should be considered Lower Oligocene and not Upper Eocene.

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[5] Note: The various species of *Hantkenina* are well limited and make excellent markers for Mexican formations. *H. alabamensis* and *H. brevispina* are confined to the Chapapote; *H. longispina* to the Guayabal and *H. mexicana* to the un-named formation below the Tempoal.

Hantkenina brevispina Cushman

Hantkenina brevispina Cushman, Proc. U. S. Nat. Mus., vol. 66, art. 30, p. 2, pl. 2, fig. 3, 1924.

Hantkenina brevispina Cushman, Cont. Cush. Lab. Foram. Res., vol. 1, No. 1, p. 7, pl. 1, fig. 10, 1925.

This species is also abundant at the type locality of the Chapapote. It is very characteristic and easily distinguished from *H. alabamensis.* This form is confined evidently to the Chapapote. It should prove to be an excellent horizon marker.

FAMILY BULIMINIDÆ

GENUS BULIMINA d'Orbigny, 1826

Bulimina tuxpamensis n. sp. Plate 1, fig. 23

Test stout, tapering, very regular in outline, broadest near the apertural end, very finely perforate; chambers but slightly inflated, numerous; sutures in most specimens relatively wide, limbate; aperture loop-like or comma shaped, extremely terminal, the most extreme specimens having the aperture almost straight across the end of the test.

Length 0.75 mm.

This *Bulimina* with its regular outline which in some specimens tends to become slightly three sided, is a very good marker for certain horizons of the Chapapote as its vertical range seems to be limited. The figured specimen is from the Huasteca Petroleum Company's well, Cerro Azul No. 75 at the depth of 1040′.

GENUS BOLIVINA d'Orbigny, 1839

Bolivina jacksonensis Cushman and Applin

Bolivina jacksonensis Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, p. 167, pl. 7, figs. 3, 4, 1926.

There are specimens in the Chapapote which agree in every detail with Cushman's and Applin's figures and descriptions of the form found in the Texas Eocene. While these forms are often abundant, in the Chapapote, they are commonly overlooked on account of their small size.

Bolivina jacksonensis Cushman and Applin, var. **striatella** Cushman and Applin

Bolivina jacksonensis Cushman and Applin, var. *striatella* Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, p. 67, pl. 7, figs. 5, 6, 1926.

This variety is associated with the true *B. jacksonensis* in the

Chapapote strata. It is very similar to that form except that the costæ in the Mexican specimens appear to be less numerous and heavier. At some horizons, this form is abundant, but only a few were found in the sample from the type locality.

GENUS UVIGERINA d'Orbigny, 1826

Uvigerina byramensis Cushman, var. Plate 2, fig. 7

In the Chapapote material, there occur rarely, specimens of *Uvigerina* that may be referred to Cushman's *U. byramensis.* While these specimens agree in general shape and arrangement with *U. byramensis* the last chamber is not quite typical. On account of its small size and great rarity, it is valueless as a stratigraphic marker.

The true *U.byramensis* is found in great numbers in the Alazan strata where it proves to be an excellent marker.

Uvigerina cf. U. gardneræ Cushman Plate 2, fig. 5

Uvigerina gardneræ, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, p. 175, pl. 8, figs. 16, 17, 1926.

Only one specimen of this species was found in the Chapapote sample from the type locality. It is very close to the one described by Cushman from Texas. While this species is never abundant it is a constant form throughout the Chapapote. Specimens of it are present in nearly all the samples examined.

FAMILY ELLIPSOIDINIDÆ

GENUS PLEUROSTOMELLA Reuss, 1860

Pleurostomella alternans Schwager

Pleurostomella alternans Schwager, Novara-Exped. Geol. Theil., pt. 2, p. 239, pl. 6, figs. 79, 80, 1866.

Pleurostomella alternans Chapman, Pal. Bull. 11, New Zeal. Geol. Sur., p. 41, pl. 9, fig. 9, 1926.

Pleurostomella alternans Cushman, Cont. Cush. Lab. Foram. Res., vol. 3, pt. 2, p. 129, pl. 25, figs. 7, 8, 28, 1927.

As Cushman has already noted under his discussion of the Genus *Pleurostomella,* the Mexican forms are very similar to *P. alternans.* For the present, it is considered best to place these forms under this species.

GENUS NODOSARELLA Rzehak, 1895

Nodosarella salmojraghii Martinotti Plate 1, fig. 6

Nodosarella salmojraghii Martinotti, Atti. Soc. Ital. Sci. Nat., vol. 61, pt. 1, p. 347, pl. 7, figs. 58-60, fig. 28 (in text) 1922.

The Chapapote forms of this species seem quite similar to those figured from Italy. The test of the Chapapote form while having the same number and general arrangement of chambers, differs in not being so straight and also in being slightly stouter.

GENUS ELLIPSONODOSARIA A. Silvestri, 1900

Ellipsonodosaria rotundata (d'Orbigny) Plate 3, fig. 13

Lingulina rotundata d'Orbigny, Foram. Foss. Bass. Tert. Vienne, p. 61, pl. 2, figs. 48-51, 1846.

Nodosarella rotundata Martinotti, Atti. Soc. Ital. Sci. Nat., vol. 64, p. 178, pl. 4, figs. 18-21, 1925.

This species is identical with the forms found in Europe. It occurs in some abundance at various horizons in the Chapapote. It should prove to be a very good stratigraphic marker as its vertical range appears to be limited.

GENUS DISCORBIS Lamarck, 1808

Discorbis jacksonensis Cushman and Applin

Discorbis jacksonensis Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, p. 178, pl. 9, figs. 8, 9, 1926.

Small forms that may be definitely referred to this species described from the Upper Eocene of Texas are found infrequently in the Chapapote. It is very true to the Texas type.

FAMILY ROTALIIDÆ

GENUS LAMARCKINA Berthelin, 1880

Lamarckina chapapotensis n. sp. Plate 3, fig. 16

Test nearly circular in outline; periphery slightly lobulate, fairly thin; generally plano-convex; five chambers in the last formed coil; dorsal side evenly convex, ventral side nearly flat to strongly concave; sutures depressed on the ventral side, flush with the surface on the dorsal side; ventrally strongly umbilicate, highly polished; aperture rather large, opening into the umbilicus, hidden by a rather large semicircular lip.

Diameter 0.9 mm.

Of all the described *Lamarckinas,* this species most nearly resembles *L. ocalana* Cushman from the Ocala limestone. It differs from *L. ocalana* in that five chambers in the last formed whorl are constantly present, in that it is not keeled and in that it is concave-convex instead of slightly biconvex. This species, while rare, seems to be confined to the Chapapote.

GENUS GYROIDINA d'Orbigny, 1826

Gyroidina girardana (Reuss)

Rotalina girardana Reuss, Zeitschr. d. Deutsch. Geol. Gesellsch., vol. 3, p. 73, pl. 5, fig. 34, 1851.

Gyroidina girardana Cushman, Jour. of Pal., vol. 1, No. 2, p. 164, pl. 25, figs. 7-9, 1927.

This form in the Chapapote, as has been noted already by Cushman, seems to be identical with Reuss' species. It is rather common at many horizons of the Chapapote and probably extends into the Alazan. It is very near *G. guayabalensis*, but differs in shape and also in having the chambers in the last coil more angulate. It is also considerably larger.

GENUS ROTALIATINA Cushman, 1925

Rotaliatina mexicana Cushman Plate3, figs. 3, 4

Rotaliatina mexicana Cushman, Cont. Cush. Lab. Foram. Res., vol. 1, pt. 1, pp. 4, 5, pl. 1, figs. 1a-c, 1925.

This species is very characteristic of the Chapapote. It may be considered one of the index fossils of that formation. While it is never abundant, it always occurs sparingly in samples, at least from the lower upper and middle portions of that formation. Some of the specimens have the spire considerably more elongate but as there are all gradations, the writer does not consider the high spiraled type as a good variety.

GENUS EPONIDES Montfort, 1808

Epinoides umbonata (Reuss) Plate 2, fig. 6

Rotalina umbonata Reuss, Zeitschr. d. Deutsch. Geol. Gessellsch., vol. 3, p. 75, pl. 5, figs. 35a-c, 1851.

Pulvinulina umbonata Reuss, Denkschi. d. k. Akad. Wiss. Wien., vol. 25, p. 206, 1866.

Pulvinulina umbonata Hantken, Mittheil Jahrb. d. k. ungar Geol. Anstalt, vol. 4, p. 77, pl. 9, figs. 8a-c, 1875.

This form seems very close to the European form described by Reuss. For the present, I am placing it under his species.

FAMILY CASSIDULINIDÆ

GENUS PULVINULINELLA Cushman, 1926

Pulvinulinella culter (Parker and Jones) var. **mexicana** Cole

Pulvinulinella culter Cushman, Jour. of Pal., vol. 1, No. 2, p. 167, pl. 26, figs. 8, 9, 1927.

Pulvinulinella culter (Parker and Jones) var. *mexicana* Cole, Bull. Amer. Pal., p. 31, pl. 1, figs. 15, 16, 1927.

This variety described from the Guayabal, extends into and probably through the Chapapote formation. It is not abundant in any of the samples that I have seen, but is persistent throughout its range, from one to ten specimens, occurring in most of the samples studied. It has only slight significance in stratigraphic determinations.

GENUS CASSIDULINA d'Orbigny, 1826

Cassidulina globosa Hantken

Cassidulina globosa Hantken, A Magy. kir. foldt. in. Eukon., vol. 4, p. 54, pl. 16, fig. 2, 1875 (1876).
Cassidulina globosa Hantken, Mittheil Jahrb. d. k. ungar Geol. Anstalt., vol. 4, p. 64, pl. 16, fig. 2, 1875 (1881).
Cassidulina globosa Cushman, Jour. of Pal., vol. 1, No. 2, p. 167, pl. 26, fig. 13, 1927.
Cassidulina globosa Cole, Bull. Amer. Pal., vol. 14, No. 51, p. 32, 1927.

This species of *Cassidulina,* which Cushman has already reported, occurs rarely in the Chapapote. At some horizons, it becomes rather abundant, but in the horizon represented at the type locality of the Chapapote formation, it is rare. It is very constant in form throughout its range in the Mexican Eocene formations.

FAMILY CHILOSTOMELLIDÆ

GENUS CHILOSTOMELLOIDES Cushman, 1926

Chilostomelloides oviformis (Sherborn and Chapman)

Lagena (Obliquina) oviformis Sherborn and Chapman, Jour. Roy. Micro. Soc., p. 745, pl. 14, figs. 19a-d, 1886.
Chilostomella oviformis Sherborn and Chapman, Jour. Roy. Micro. Soc., p. 485, pl. 11, fig. 13, 1889.
Chilostomelloides oviformis Cushman, Cont. Cush. Lab. Foram. Res., vol. 1, pt. 4, p. 77, pl. 11, figs. 17a-d, 21a-c, 1926
Chilostomelloides oviformis Cushman, Jour. of Pal., vol. 1, No. 2, p. 168, pl. 26, fig. 10, 1927.

Specimens of this species are encountered rarely in the Chapapote. Cushman has listed it from the typical Alazan. I doubt if this species occurs in the Alazan, as I have not seen it in any of the samples which I have regarded as typical Alazan. Although it is rare, it should be a good marker for certain horizons of the Chapapote.

FAMILY GLOBIGERINIDÆ

GENUS GLOBIGERINA d'Orbigny, 1826

Globigerina bulloides d'Orbigny

Globigerina bulloides d'Orbigny, Ann. Sci. Nat., vol. 7, p. 277, 1826.
Globigerina bulloides H. B. Brady, Rept. Voy. Challenger Zoo., vol. 9, p. 593, pl. 77, figs. 3-7, 1884.

This is a common species at some horizons of the Chapapote. It is valueless as a stratigraphic marker on account of its great vertical and horizontal range.

Globigerina cerro-azulensis n. sp. Plate 1, figs. 11, 12, 13

Test relatively large for the genus, rotaliform, dorsal side very flat, ventral side strongly convex, periphery angulate, chambers few, inflated, about four in the last formed coil, rapidly increasing in size so that the last makes up over one-fourth of the test; sutures distinct, depressed; wall very finely granular; aperture rather large, extending from the periphery to the umbilicus.

Diameter 0.54 mm. Height 0.33 mm.

The erecting of this species required considerable courage on my part, as it is very near the form to which Galloway and Wissler applied the name *G. crassaformis.* It differs from this species in not being umbilicate and in the less angularity of the periphery. The aperture is also larger and the shape of the chambers slightly different.

Globigerina eocæna Gumbel Plate 1, fig. 20

Globigerina eocæna Gumbel, Abh. k. bay. Akad. Wiss., vol. 10, p. 662, pl. 2, figs. 109a-b, 1868.

The specimens of this form from the Upper Eocene of Mexico are very similar to the species described by Gumbel from the Upper Eocene of the Bavarian Alps. The specimens appear so near like figures given by Gumbel that no differences could be noted.

Globigerina eocænica Terquem Plate 1, fig. 10; Plate 3, fig. 8

Globigerina eocænica Terquem, Mem. Soc. Geol. de France, ser. 3, No. 2, p. 86, pl. 9, fig. 4, 1882.

This species is very close to the one described by Terquem from the Eocene of France. It is abundant and characteristic of certain horizons of the Chapapote and should make an excellent marker on account of its abundance.

Globigerina inflata d'Orbigny

Globigerina inflata d'Orbigny, Hist. Nat. Isles Canaries, vol. 2, pt. 2, Forams. p. 134, pl. 2, figs. 7-9, 1839.

Globigerina inflata H. B. Brady, Rept. Voy. Challenger, Zoo., vol. 9, p. 601, p. 79, figs. 8-10, 1884.

Globigerina inflata Cole, Bull. Amer. Pal., vol. 14, No. 51, p. 33, pl. 4, fig. 19, 1927.

Except on the basis of state of preservation, the Guayabal and Chapapote forms of this species can not be distinguished. This species has a great range in the Tertiary formation of Mexico and elsewhere. It is very abundant at most all horizons. For stratigraphic work, this species has no significance.

Globigerina mexicana Cushman Plate 2, fig. 11

Globigerina mexicana Cushman, Cont. Cush. Lab. Foram. Res., vol. 1, No. 1, p. 6, pl. 1, figs. 8a, b, 1925.

Globigerina mexicana Cushman, Jour. of Pal., vol. 1, No. 2, p. 168, pl. 26, figs. 16, 17, 1927.

This striking species is confined to the lowest eighty feet of the Chapapote. Its short vertical, but wide horizontal range makes it a splendid marker. In some samples, this form is very abundant. The figured specimen is from the Huasteca well, Cerro Azul No. 75 at 1100′.

FAMILY ANOMALINIDÆ

GENUS ANOMALINA d'Orbigny, 1826

Anomalina dorri n. sp. Plate 3, figs. 1, 2

Test nautiloid, slightly asymmetrical, composed of about three coils with 8-10 chambers in the last formed volution; umbilici in most specimens concave, although in some the dorsal umbilicus is slightly convex; wall coarsely perforate; ventrally the sutures raised into distinct welts or ridges which sometimes extend over to the dorsal side, with the exception of the last suture which is generally depressed; dorsally the sutures are flush with the surface or slightly depressed; periphery broadly rounded; aperture a narrow curved slit at the base of the last chamber.

Diameter 1.25 mm.

This *Anomalina* is one of the most striking species of the Chapapote to which it is confined. Although it is rare, it is generally found in samples from all horizons. The highly raised sutures makes this species distinct from all the described species of *Anomalina.*

This species is named in honor of Mr. James B. Dorr, Paleontologist of the Huasteca Peroleum Company at Tampico, Mexico.

Anomalina grosserugosa (Gumbel) Plate 1, figs. 16, 17

Truncatulina grosserugosa Gumbel, Abh. k. bay. Akad. Wiss., vol. 10, p. 660, pl. 2, fig. 104, 1868.

Anomalina grosserugosa H. B. Brady, Rept. Voy. Challenger, Zoo., vol. 9, p. 673, pl. 94, figs. 4, 5, 1884.

Anomalina grosserugosa Chapman, Proc. Calif. Acad. Sci., ser. 3, vol. 1, p. 253, pl. 30, fig. 9, 1900.

This well known and much described species occurs in the

Chapapote. It follows the type, as described by Gumbel, very closely. It is rather characteristic of the Chapapote, but I cannot say that it is confined to that formation entirely, as I have seen specimens in other Mexican formations that resemble this one closely, but this may have been due to contamination.

Anomalina umbonata Cushman

Anomalina umbonata Cushman, Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, p. 300, pl. 7, figs. 5, 6, 1925.
Anomalina umbonata Cushman, Jour. of Pal., vol. 1, No. 2, p. 170, pl. 27, figs. 10, 11, 1927.
Anomalina umbonata Cole, Bull. Amer. Pal., vol. 14, No. 51, p. 35, 1927.

Except in the matter of state preservation, specimens of this species are identical with those from the Moctezuma river and from the type locality of the Guayabal. It is one of the few fossils which occur abundantly in the Guayabal, but extends into the Chapapote. It is very rare in the Chapapote formation and is valueless as a stratigraphic marker.

GENUS CIBICIDES Montfort, 1808

Cibicides tuxpamensis n. sp. Plate 1, figs. 2, 3; Plate 3, figs. 5, 6

Test large, plano-convex to bi-convex, ventral side very strongly convex; dorsal side only slightly so, 7-9 chambers in the last formed whorl; wall coarsely perforate, sutures limbate especially on the ventral side; flush with the surface, except between the last formed chambers on the dorsal side where they are slightly depressed; a large umbonal mass of clear shell material ventrally; aperture only extending very slightly over on the dorsal side.

Diameter 1.20 mm.

This species differs from the common Cibicides in the Guayabal which I have referred to *C. conoideus* Galloway and Wissler, in its greater size, smaller number of chambers in the final volution and its greater biconvexity. I am also figuring slightly smaller specimens which are evidently the megalospheric form of this species.

SOME FURTHER NOTES ON THE GUAYABAL FAUNA

Since the publication of my paper in vol. 14, No. 51, of this Bulletin, I have found the following species which were not previously reported from this formation and one species which it is necessary to revise. The following specimens are all from the sample taken at the type locality of the Guayabal.

Ceratobulimina eximia (Rzehak)

Pulvinulina eximia Rzehak, Ann. K. K. Nat. Hofmuseums, vol. 3, pt. 3, p. 263, pl. 11, figs. 7a-c, 1888.
Ceratobulimina eximia Cushman, Cont. Cush. Lab. Foram. Res., vol. 3, pt. 4, p. 174, pl. 29, figs. 3, 4, pl. 30, figs. 12-16, 1927.
Rotalia dorri Cole. Bull. Amer. Pal., vol. 14, No. 51, p. 29, pl. 4, figs. 5, 6, 1927.

In the paper on the Guayabal, I classified this form under the wrong genus, due to the aperture being broken away. I have had the opportunity, since that time, of examining specimens from the Claiborne of the United States. With a complete series from that formation and a set of younger specimens from the Guayabal, I have been able to correlate it properly under Rzehak's species. The finding of this form helps to substantiate my contention in regard to the age of the Guayabal.

Nodosaria arundinea Schwager

Nodosaria arundinea Schwager, Novara Exped. Geol. Theil., pt. 2, p. 211, pl. 5, figs. 43-45, 1866.
Nodosaria arundinea Cushman and Hanna, Proc. Calif. Acad. Sci., vol. 16, No. 8, p. 215, pl. 13, fig. 14, 1927.

This species has been recorded from the Eocene of Europe and has been found also by Cushman and Hanna in the Eocene of California. It occurs very infrequently in the Guayabal.

Chilostomella ovoidea Reuss Plate 2, fig. 10

Chilostomella ovoidea Reuss, Denkschr. Akad. Wiss. Wien., vol. 1, p. 380, pl. 48, figs. 12a-e, 1850.
Chilostomella ovoidea Cushman, Cont. Cush. Lab. Foram. Res. vol. 1, pt. 4, p. 74, pl. 11, figs. 1a-e, 1926.

The Guayabal specimens are very near Reuss' species. *Chilostomella ovoidea* is found only infrequently in the Guayabal.

Robulus propinquus (Hantken)

Cristellaria propinqua Hantken, K. ungar. geol. Anstalt, vol. 4, p. 52, pl. 5, fig. 4, (1876 [1881]).
Cristellaria propinqua Cushman and Applin, Bull. Amer. Assoc. Petrol. Geol., vol. 10, No. 2, p. 172, pl. 8, fig. 9, 1926.

The Guayabal specimens appear to be identical with the European and Texas forms. Only a few specimens have been found.

Siphonina claibornensis Cushman

Siphonina claibornensis Cushman, Proc. U. S. Nat. Mus., vol. 72, art. 20, pp. 4-5, pl. 3, figs. 5a-c.

This species occurs rather commonly in the Guayabal where it is associated with *S. tenuicarinata.*

A NEW LEPIDOCYCLINA FROM THE UPPER OLIGOCENE IN MEXICO

Lepidocyclina (Lepidocyclina) waylandvaughani n. sp; Plate 4, figs. 1-8

Test thin, waferlike without any pronounced umbo; generally flattened, but occasionally slightly sellæform; surface smooth, occasionally obscurely reticulate, especially toward the margins; entirely without papillæ, except a few very small ones which are sometimes present in the umbonal region.

Embryonic chambers nearly equal, separated by a straight wall; outer wall moderately thick, about 0.028mm.; greatest diameter of the embryonic chambers 0.53mm., the least 0.42mm.

Equatorial chambers hexagonal, becoming ogival in the outer rings.

In the vertical section, the number of lateral chambers over the center in the megalospheric form, on each side of the equatorial chambers are 5 to 6, which gradually decrease in number toward the periphery. Equatorial chambers very small at the center, gradually increasing in size as they approach the periphery until they occupy the entire thickness of the test. At the periphery, the equatorial chambers are twice as high as broad. The lateral chambers are low, compressed and relatively thick walled; pillars few and weakly developed.

Diameter of the megolospheric form 8 mm; thickness 0.70 to 0.80 mm.

One form of the species developes lobes to such an extent that it almost forms a cross. All graduations between the perfectly round forms and the extreme development of the "cross" form, may be found, although the lobate forms are rather scarce.

This species is nearest *Lepidocyclina parvula* Cushman, from which it differs in its larger size, more compressed form, weakly developed pillars and finer papillæ.

It occurs in great abundance in a clayey layer above a massive sandstone in a quarry on the Huasteca Petroleum Company's golf course opposite Tampico. The holotype is from this locality. Associated with this form are a few *Lepidocyclina* sp. aff. *L. morgani,* abundant *Rotalia* sp. (figured by Cushman in the Journal of Paleontology Pl. 26, fig. 5) and *Themeon* sp. also abundant. These forms seem to characterize this horizon which from its position may be assumed to be Upper San Rafæl, very near the Miocene contact.

Dr. Vaughan, in whose honor this species was named, was kind enough to examine specimens of this species at my request. He informs me that he has known of this species from Antigua for a number of years. To date, he had not applied a name to it because of his doubt as to its relation to *parvula.* However, he says, "It appears to me to be more closely related to *L. parvula* Cushman, but that species is usually thicker through the center, even to being inflated and the papillæ are coarser. However, there is a tremendous amount of variation. Since I have not yet reached a positive decision regarding what to do with the form, I hesitate to advise you. Because of the two differences above mentioned, I should hesitate to apply the name *parvula* to it, but the form runs very close to the flatter varieties of *parvula.*"

In the future, with more work and more specimens, *Lepidocyclina waylandvaughani* may prove to be only a variety of *parvula,* but as the differences noted seem constant for the Mexican forms and the true *parvula* or even anything approaching it have not been found in Mexico to date, the author feels that this form is deserving of specific rank.

Lepidocyclina aff. L. morgani Lem. and Douvillé Plate 4, fig. 9

Lepidocyclina cf. marginata H. Douvillé, Bull. Soc. Geol. de France, ser. 3, vol. 18, p. 1001, 1900.
Lepidocyclina morgani Lem. and R. Douvillé, Soc. Geol. de France, Paleont., vol. 12, Mem. 32, p. 17, pl. 1, figs. 12, 15, 17; pl. 2, figs. 4, 12; pl. 3, fig. 2, 1904.
Lepidocyclina morgani Cushman, Carnegie Inst., Washington, Pub. 291, p. 59, pl. 11, figs. 1 to 3, fig. 7, (in text) 1919.

This forms seems to be the only other *Lepidocyclina* associated with *waylandvaughani* at the horizon under discussion. It is fairly rare. To date, I have not been able to obtain a megalospheric form, but the microspheric seems very close to *L. morgani.*

MEXICAN FORAMINIFERAL LITERATURE

No attempt has been made to give a complete synonymy, but for the convenience of future workers on the Mexican Foraminifera, a list is given of the papers which have specifically described Mexican forms.

1. Cole, W. S. A Foraminiferal Fauna from the Guayabal Formation in Mexico. Bull. Amer. Pal., vol. 14, No. 51, pp. 1-46, pls. 1-5, 1927.
2. Cushman, J. A. American Species of Orthophragmina and Lepidocyclina. U. S. Geol. Sur. Prof. Paper 125, pp. 39-105, pls. 7-35, 1920.
3. ———— A New Genus of Eocene Foraminifera. Proc. U. S. Nat. Mus. vol. 66, art. 30, pp. 1-4, pls. 1-2, 1924.
4. ———— An Eocene Fauna from the Moctezuma River Mexico. Bull. Amer. Assoc. Petrol. Geol., vol. 9, No. 2, pp. 298-303, pl. 6-8, 1925.
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PLATES 1 - 4

Note: Unless otherwise stated under the description of the species, all the holotypes are from the type locality of the Chapapote. With the exception of the *Lepidocyclina* holotype, all the others have been deposited in the Eocene collection of Professor G. D. Harris at Cornell University. The figured holotypes and paratypes of the *Lepidocyclina*, I am retaining in my personal collection for the present.

Prnited plates furnished by Mr. W. S. Cole. -- Eds.

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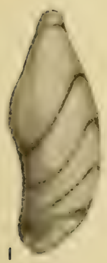
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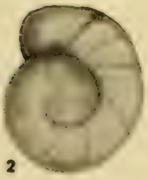
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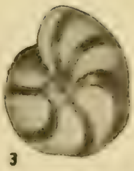
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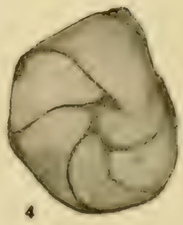
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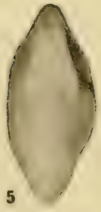
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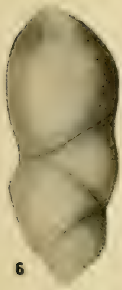
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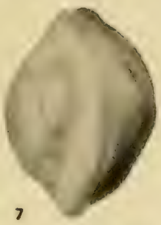
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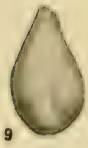
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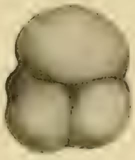
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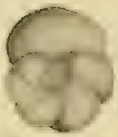
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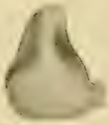
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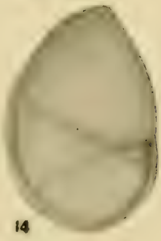
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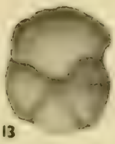
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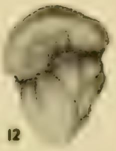
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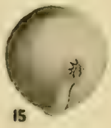
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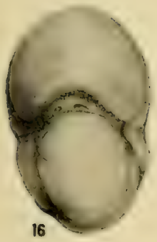
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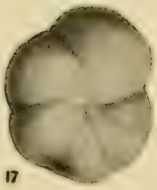
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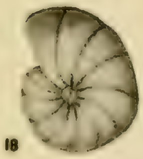
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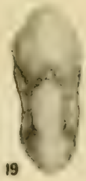
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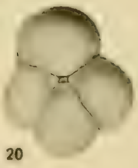
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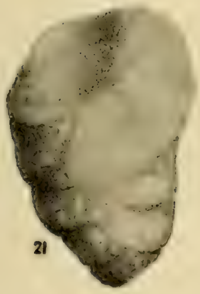
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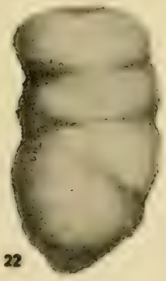
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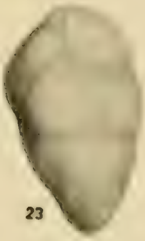
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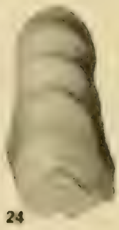
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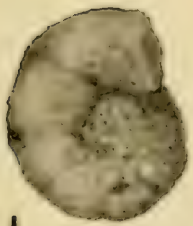
10.	**Chilostomella ovoidea** Reuss; x 80	20
11.	**Globigerina mexicana** Cushman; x 50	18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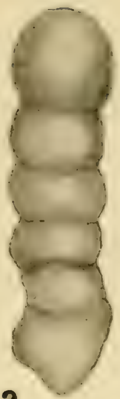
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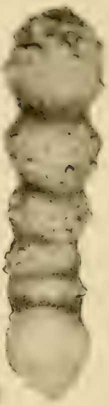
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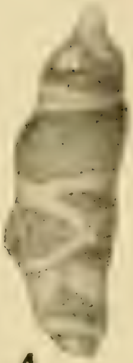
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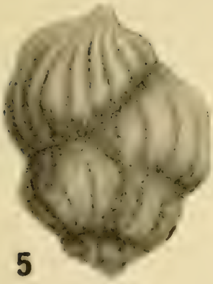
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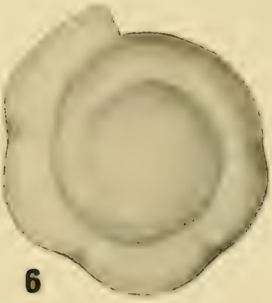
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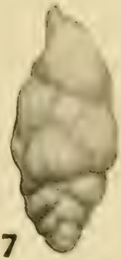
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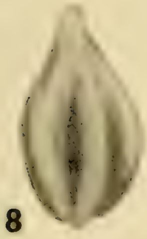
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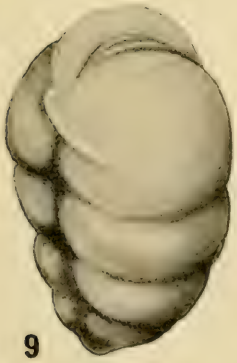
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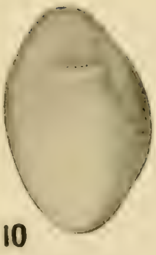
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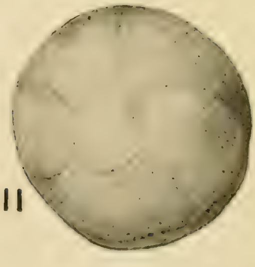
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Explanation of Plate 3

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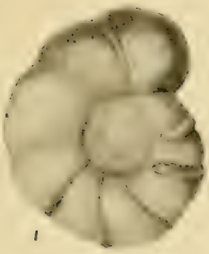
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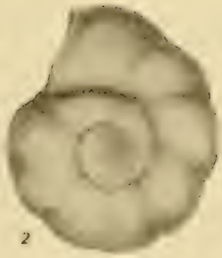
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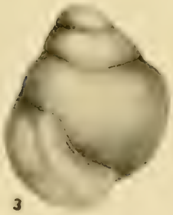
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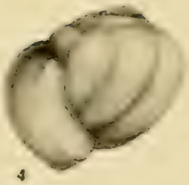
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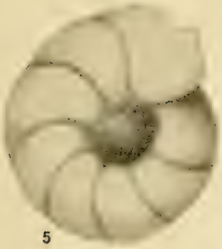
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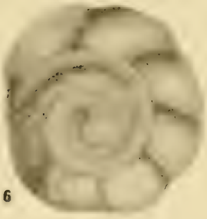
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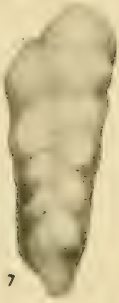
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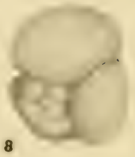
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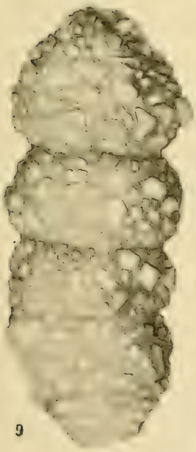
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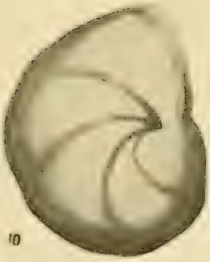
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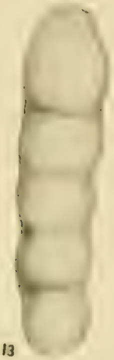
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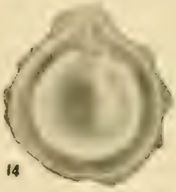
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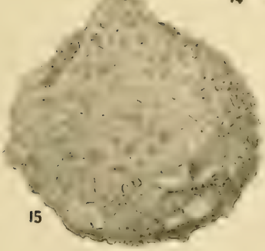
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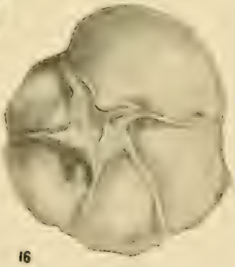
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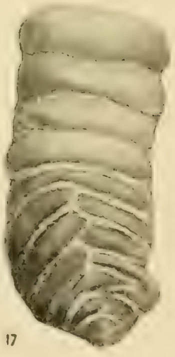
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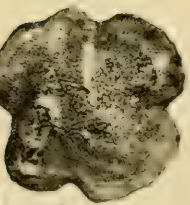

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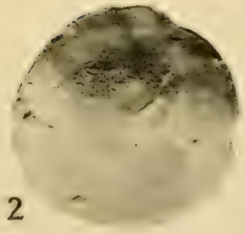

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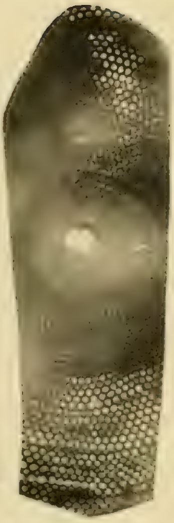

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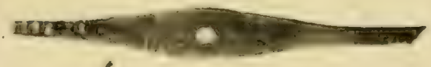

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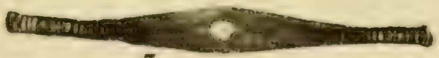

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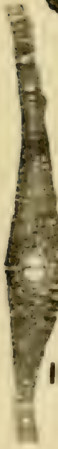

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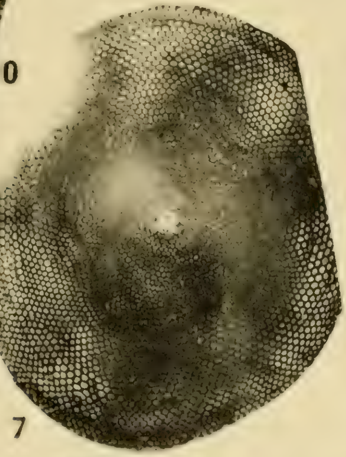

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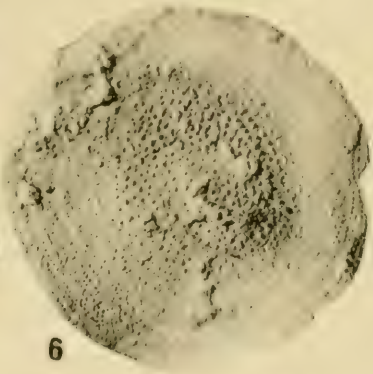

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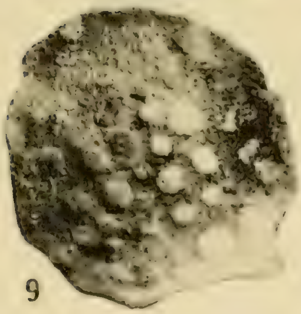

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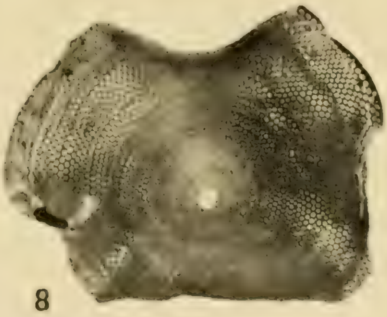

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SMITHSONIAN INSTITUTION
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MIOCENE MOLLUSCA OF NORTHERN COLOMBIA

By Norman Edward Weisbord

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Harris Co.
Ithaca, N.Y.
U. S. A.

INTRODUCTION

The purpose of this paper is to contribute additional information of the rapidly increasing knowledge of the Caribbean Miocene deposits of northern South America. During the course of geologic investigations in Colombia the writer was afforded opportunity of making collections in horizons ranging from Cretaceous to Quaternary in various parts of the country; but at this time only a few notes on the Miocene paleontology can be given. Permission to publish has been most generously granted by Mr. J. E. Brantly of the Colombian Atlantic Refining Company to whom the writer has been constantly indebted for his interest and co-operation.

Whenever possible the Colombian specimens have been compared with other Caribbean Miocene forms in the Paleontological Laboratory of Cornell University, ably presided over by Prof. G. D. Harris, to whom I am grateful for publishing this article, and with whom it has been a constant source of pleasure to be associated. On this occasion, also, I wish to offer my thanks to Mr. George L. Green and Mr. C. C. Addison for their co-operation in collecting the material.

GENERAL NOTES

The marine Miocene deposits of Colombia are widespread in their occurrence. According to Anderson[1] they occur from Rio Hacha westward to the Gulf of Urabá and to unknown distances in the valleys of San Jorge and Sinu rivers. The writer has made collections in the departments of Atlantico, Bolivar and Magdalena and is cognizant of a great thickness of Miocene beds in the Atrato river valley. Deposits which are contemporaneous in age to a portion of the Miocene section of Colombia are known in the state of Falcon, Venezuela, and in Trinidad as well as in Costa Rica, the Canal Zone, Panama, San Domingo, and Mexico. In Colombia these formations are composed, for the most part, of sandstones, shales and marls.

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[1] Anderson, F. M., Original source of oil in Colombia : Bull. Amer. Assoc. Pet. Geol., Vol. 10, No. 4, pp. 382-404, 1926.

Literature pertaining to the paleontology of the Colombian Miocene is rather scant, although there is considerable that has been written on related areas. The short paper by Pilsbry & Brown[2] on "Oligocene fossils from the neighborhood of Cartagena, Columbia" was the first short systematic treatise dealing with some of the mollusca found in what are now regarded as Miocene beds near Cartagena. In 1919 Cooke[3] listed a number of forms from a few of the same localities from which the present fauna is described, and recently Anderson[4] has presented a brief review of the stratigraphy of a portion of the Miocene section in the department of Atlantico giving a list of some of the more characteristic forms from "Stage M". This is a coarse sandstone, quite fossiliferous, and possibly rests unconformably on the underlying older formation. It is Anderson's belief that this stage is older than any other similar group of the Miocene in Colombia.

Mr. George L. Green and the writer made two collections in the Department of Atlantico, one between Las Perdices and Puerto Colombia from a light brown sandstone and the other near Usiacuri from an earthly brown marl. Mr. Addison made several collections from various localities along the coast and to the south. Under the description of each species its locality will be given. In the Department of Magdalena, Miocene fossils were found at various intervals south of Fundacion, near Paraiso and between Paraiso and Flores de Maria. The material is predominantly sandstone, generally dirty gray in color altho sometimes reddish or yellowish brown depending upon the amount of oxidation of the iron present. The Miocene sediments south of Fundacion appear in places to unconformably overlie the igneous materials comprising the western flank of the Santa Maria mountains. About eight kilometers or so south of Calamar and at Buenavista, Miocene hills fringe the margin of the Magdalena river and dip to the southeast. The Miocene sediments of the Department of Bolivar between Zambrano and

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[2] Acad. Nat. Sci. Phil. Proc., Vol. 69, Pp. 32-41, 1917

[3] U. S. Nat. Mus. Bull. 103, Pp. 588,589, 1919

[4] The marine Miocene Deposits of North Colombia: Calif. Acad. Sci. Proc., 4th ser., Vol. 16, No. 3, Pp. 87-95, 1927.

Jesús del Monte on the road to Carmen, dip to the southeast monoclinally away from the older sediments forming the folds of the central range of hills. In the section from Zambrano to Carmen two collections were made, one about four kilometers east of the hacienda of Esperanza, the other just east of Jesús del Monte on a strike ridge of sandstone overlooking the town. The thickness of Miocene in the Zambrano-Carmen section may approach as much as five thousand feet. The fossils from Jesús del Monte are stratigraphically lower than those east of Esperanza.

The conclusion that the fossils are of Miocene age has been arrived at by correlation with other known species from Caribbean Miocene deposits and by the stratigraphic relations of the beds.

DESCRIPTION of SPECIES

Class PELECYPODA Goldfuss

Order PRIONODESMACEA Dall

Superfamily ARCACEA Deshayes

Family ARCIDÆ Dall

Genus SCAPHARCA Gray

Scapharca grandis colombiensis Wiesbord, n. subsp. Pl. 1, Fig. 1

Arca grandis Pilsbry, Acad. Nat Sci. Phil. Proc., Vol. 73, Pt. 2, P. 404, Pl. 40, Fig. 1, 1921 (Not of Broderip & Sowerby?).
Cf. Scapharca (Scapharca) patricia Maury, Bull. Amer. Pal., Vol. 10, No. 42, P. 57, Pl. 2, Fig. 5, 1925.
Arca aff. grandis Cooke, U. S. Nat. Mus. Bull. 103, P. 588, 1919.

This is a large, thick-shelled form ornamented with 25 to 28 strong, radiating ribs. These may be somewhat rounded or flattened on top and are generally of the same width as the well channeled interspaces. Concentric growth lines impart a beaded appearance to the radiating costæ, the development of which varies on different specimens. On nearly all shells, however, the beading is more strongly pronounced than on the recent Pacific form known as *Scapharca grandis.* Otherwise the fossil and recent forms are very similar.

The outline of the shell is generally obtusely triangular with a marked tendency to become swollen when adult, especially near the ventral margin. Posteriorly it is somewhat attenuated and truncated. The cardinal area is broad and high. Some specimens show a downward projecting growth of calcium carbonate over the anterior muscle scar resembling somewhat a modified uvula of the human throat. This is well developed on some of the larger forms of the recent *grandis.*

Dimensions: Alt. 93 mm; Long. 93 mm.

This is a varietal form of the widely distributed fossil generally referred to as *Arca grandis* or *patricia* depending upon the interpretation of the describer. In 1850 Sowerby[5] described but did not figure a species from Santo Domingo which he called *Arca patricia.* In discussing it he said: "Distinguished from *A. grandis* by its form, which is much more rounded at the inferior margin; by the angularity of its radiating ribs, which are moreover more numerous; and by the narrowness of the line formed by the row of hinge teeth, and the recurved posterior of the same row."

Thinking that *Arca patricia* resembled *Arca grandis* (an inference derived from Sowerby's comparison with *grandis*) Gabb[6] later decided that a suite of *Arcas* which he collected from Santo Domingo were really identical with the recent *grandis* and relegated the name *patricia* to synonymy. Gabb also subsequently regarded *A. chiriquiensis* a synonym of *A. grandis,* but the former is now regarded as a distinct species.

In revising Gabb's material, Pilsby[7] considered that the extremely large *Arca* in the Santo Domingan collection was not the one that Sowerby meant to be *patricia* and suggested that *A. chiriquiensis* might be the species Sowerby had in mind for *patricia.* Hence he called the larger form *grandis* believing the fossil to be similar to the recent form. Maury[8] previously, however, considered the large *Arca* as *patricia,* and recognizing a difference between it and the recent *grandis* decided to retain the name originally given by Sowerby.

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[5] Geol. Sec. London, Quart. Journ., Vol. 6, p. 52, 1850.
[6] Amer Phil Soc Trans., n. ser., Vol. 15, P. 253, 1873.
[7] Acad. Nat. Sci. Phil. Proc., Vol. 73, P. 404, 1921
[8] Bull. Amer. Pal., Vol. 5, No. 29, p. 338, 1917.

The larger *Arcas* in the Santo Domingo collection are undoubtedly very close to the recent *grandis* altho the majority have higher and narrower umbos.

In order to clear up this "picturesque muddle" Woodring[9] sent for a cast of the holotype of *patricia* and found that it is very different from either *grandis* or *chiriquiensis.* Woodring found the cast to be identical with *Scapharca tolepia* Dall and the synonymous *S. arthurpennelli* Maury. If this is so it clears up a clouded situation. There is one point to be considered however. Is the cast of the holotype actually of the shell that Sowerby meant as *patricia*? There are several reasons for entertaining some doubt. In the first place there is no resemblence between adult forms of *tolepia* and *grandis.* Why then did Sowerby compare his specimen with *grandis*? Why did he give it the name *patricia* which in itself indicates a noble, patrician form. Neither *tolepia* or *arthurpennelli* would be grand enough to suggest the name *patricia.* And finally the fact that there are large shells that closely resemble the recent *grandis* makes us believe that the true *A. patricia* may be the *A. patricia* of Maury or the *A. grandis* of Gabb.

Woodring, however, has penetrated as far into the heart of the situation as may be possible. If the holotype cast truly resembles the *patricia* of Sowerby, misinterpretations have been rectified. If the type has been lost, mislabeled or mishandled the matter still stands subject to diverse interpretations.

In naming the Colombian specimen a subspecies of *grandis* I am conforming with Woodring's suggestion. It is undoubtedly very similar to the recent form of *grandis* but inasmuch as there are recognizable differences and to avoid more ambiguity in the literature I have decided to call it under the subspecific name of *colombiensis.* Pilsby has several forms from Colombia which he regards as the true *grandis.* Our form I believe is identical with the one Pilsbry figured. It is also very close to *A. patricia* Maury from Trinidad.

Localities.—Usiacuri; near Puerto Colombia; near Piedras de Afilar, Dept. of Atlantico, near Cartagena, Dept. of Bolivar.

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[9] Science, Vol. 62, No. 1614, pp. 518, 519, 1925.

Age.—Middle—Upper Miocene.

Distribution.—Nearly identical forms are found in Venezuela, San Domingo, Trinidad and Tobago?

Scapharca grandis var. cedralensis, n. var. **Pl. 1, Figs. 2, 3.**

This form seems to represent still another varietal phase of *grandis.* It differs from *colombiensis* in having a somewhat thinner shell and in being less swollen. The number of ribs vary from twenty-five to twenty-eight. These are strong, quadrate, separated by well channeled interspaces of the same width as the ribs. The shell is obtusely noded generally on the anterior. Many specimens have a shallow but broad sulcus ventrically.

Dimensions: Alt. 60 mm; Long. 65 mm.

This species appears to be closely related to *S. chiriquiensis websteri* Pilsbry from Haiti, but it has fewer, less prominently noded ribs.

Locality.—Near Cedral, Dept. of Atlantico.

Age.—Middle - Upper Miocene.

Scapharca chiriquiensis Gabb var. **bolivari** Weisbord, n. var. **Pl. 1, Figs. 4-9**

Shell of medium size, varying considerably in shape. Some of the larger shells are much like *chiriquiensis* lacking, however, the twisted appearance so characteristic of the Santo Domingan species. Some of the smaller shells are longer and high and resemble *Scaphareca websteri* Pilsby. These various forms however appear to intergrade and hence I am considering them as the same species.

Left valve with twenty-nine of thirty square ribs which are closely sculptured with equal transverse nodules. On the posterior slope the ribs are weaker and simple. The right valve has about twenty-eight ribs similarly sculptured. Most of the shells have a tendancy to become slightly depressed behind the middle in front of the posterior truncation and are all well inflated. Cardinal area of moderate width with one to seven resiliary grooves depending upon the amount of developement of the shell. Hinge rather narrow bearing numerous, closely spaced teeth which are smaller medially and larger distally, the marginal ones slightly oblique.

Dimensions: Alt. 39 mm; Long. 43 mm. Adult specimen
Alt. 21 mm; Long. 30 mm.
Alt. 29 mm; Long. 37 mm.

The larger specimens differ from the true *chiriquiensis* in being less depressed behind the middle, less irregularly swollen and with relatively lower beaks. Some specimens closely resemble *S. chiriquiensis websteri* especially those figured by Woodring[10], but the poserior margin is rather uniformly more acutely sloping than on the Haitian form.

Locality.—About 4 kilometers east of Esperanza, Dept. of Bolivar.

Age.—Middle Miocene.

Scapharca pittieri Dall Pl. 1, Figs. 10, 11

Arca (Scapharca) pittieri Dall, Smith. Misc. Coll., Vol. 59, No. 2, P. 9, 1912.
Arca pittieri Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 192, Pl. 24, Figs. 2-6, 1922.

Comparison with specimens from Costa Rica show the Colombian shells to be practically identical with *pittiori.* In his original description Dall says ". . . . *anterior* end attenuated and produced but not sharply truncated, *posterior* end much shorter and very bluntly rounded. . . ."; and again, ". . . . hinge line straight, the tooth series divided somewhat in front of the beak with about twenty-two *anterior* and eighteen *posterior,* closely adjacent, slightly wavy, flat teeth." This diagnosis fits our shells except that the anterior and posterior are opposite of that spoken of in the original description. In the original description anterior and posterior should be reversed.

Dimensions: Alt. 22 mm; Long. 23 mm.

The somewhat more elongated outline differentiates this species from *A. hindsii* and *A. lloydi* Olsson. The Venezuelan *A. berjadinensis* Hodson[11] is smaller but closely allied to younger forms of *pittieri. Scapharca hispanioliana* Maury[12] from Santo Domingo is superficially quite similar but the amphidetic area in *pittieri* is not partially obscured by the ribbing as in the other.

Locality.—Between Sibarco and Piedras de Afilar, Dept. of Atlantico.

Age.—Miocene.

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[10] Geology of the Republic of Haiti, Pl. 13, Figs. 9-11, 1924.
[11] Bull. Amer. Pal., Vol. 13, No. 49, p. 6, pl. 4, figs. 1-3, 5, 1927.
[12] Ibid, Vol. 5, No. 29, p. 176, pl. 30, figs. 9, 10, 1927.

Distribution.—Costa Rica; Colombia.

Genus GLYCYMERIS Da Costa

Glycymeris lloydsmithi Pilsbry & Brown Pl. 1, Figs. 12, 13

Glycymeris lloydsmithi Pilsbry & Brown, Acad. Nat. Sci. Phil. Proc., Vol. 69, P. 39, Pl. 6, Fig. 6, 1917.
Glycymeris lloydsmithi Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 181, Pl. 25, Figs. 8-10, 1922.
Glycymeris lloydsmithi Anderson, Calif. Acad. Sci. Proc., 4th ser., Vol. 16, No. 3, P. 89, 1927.

The shell is slightly inequilateral with somewhat straightened umbonal margins. There are about 27 low, broad, rounded ribs. On our specimens these ribs do not become appreciably weaker ventrally as on the specimen originally described by Pilsbry & Brown. The cardinal area is small and not grooved.

Dimensions: Alt. 37 mm; Long. 35 mm.

This species is distinguished from *G. canalis* by the absence of V-shaped grooves in the cardinal area.

Localities.—Near Usiacuri; near Puerto Colombia; Morro Hermoso, in the Dept. of Atlantico.

Age.—Middle - Upper Miocene.

Distribution.—N. of Urumaco, Falcon, Venezuela; Red Cliff and Middle Creek, Costa Rica; Colombia.

Glycymeris lloydsmithi multicostata Weisbord n. subsp. Pl. 2, figs. 1, 2

Shell of medium size, moderately convex, subcircular in outline. Cardinal area narrow, small and smooth. There are 15 teeth before the beak and 16 behind. The teeth are angularly bent near the beak but are straight marginally and all are vertically striated. The ribs vary from 23 to 27 in number. Umbonally they are simple, strong and convex. Medially the ribs become tripartite, arranged so that the middle part is broader and more elevated than the two sides. Near the base of the shell this broad part of the rib may become split, dividing it into four parts. Within, there are about 18 broad denticles on the margin. Crossing the valve are numerous, regular, fine, growth striae.

Dimensions: Alt. 36 mm; Long. 34 mm.

This species is a more highly developed form of *lloydsmithi* and may prove to represent a more rugged form of that species. It is generally, though not always, more circular in outline, has more teeth in the hinge and has prominent multicostate ribs. *G. democraciana* Hodson is very similar to the species under discussion but differs somewhat in its more irregular shape. The Venezuelan shell is probably a varietal form of *llyodsmithi* rather than *canalis* inasmuch as it lacks the grooves on the cardinal area. Superficially the Colombian form resembles *G. canalis trilobicosta* Pilsbry & Brown but differs in being larger and lacking the grooves on the cardinal area. *Pectunculus gatunensis* described by Toula has somewhat the same surface features but is much smaller and is probably a varietal form of *G. canalis*.

Localities.—Piedras de Afilar; Morro Hermoso, in the Dept. of Atlanaico.

Age.—Miocene.

Glycymeris canalis var. colombiensis Weisbord n. var. Pl. 2, figs. 3, 4

Shell rather small, subtriangular, slightly inequilateral. Hingeline short, slightly sloping; cardinal area narrow, sculptured with three or four well incised, angulate, V-shaped grooves. Hinge with 10 to 13 teeth before the beak and 11 to 15 behind. Ventral margin with about 15 to 17 denticles. Ribs low, broad, slightly convex, usually simple but occasionally having a tendency to become tripartite toward the base. The number varies from 24 to 27. Obsolete concentric growth striae cross the valve.

Dimensions: Alt. 24 mm; Long. 22mm.

Differs from the true *canalis* in its more subdued ribbing.

Localities.—Near Pto. Colombia; Piedras de Afilar, in the Dept. of Atlantico.

Age.—Miocene.

Glycymeris cf. tumefactus Pilsbry and Brown Pl. 2, fig. 5

Glycymeris tumefactus Pilsbry and Brown, Acad. Nat. Sci. Phil. Proc., Vol. 69, P. 38, Pl. 6, fig. 7, 1917.

A weathered specimen in our collection is seemingly referable to this species, though our shell is slightly more circular in form. There are several small vertical teeth below the beak. These are somewhat larger and angularly bent medially but become smaller and oblique distally. There are about 15 after the beak.

Dimensions: Alt. 42 mm; Long. 44 mm. Approximately.

Differs from *G. jamaicensis, pennaceus* and *carbasina* in lacking the fine radial striae characteristic of the group.

Locality.—Near Tubera, Dept. of Atlantico.

Age.—Miocene.

Superfamily OSTRACEA Goldfuss

Family OSTREIDÆ Lamarck

Genus OSTREA Linnaeus

Ostrea osculum Pilsbury and Brown Pl. 2, figs. 6, 7

Ostrea sculpturata osculum Pilsbry and Brown, Acad. Nat. Sci. Phil., Proc., Vol. 69, P. 40, Pl. 6, Figs. 2, 2a, 1927.

This is quite a variable form. Our shells are thin and have a yellowish tinge. The lower or left valve may be subovate, sickle-shaped or claw-like in outline varying also in the degree of inflation. Valves have two of more folds which vary from wavy undulations to acute angulations. The muscular scars are lightly impressed, pear-shaped, with a narrow tapering end pointed obliquely toward the beak. Resilium small, triangular. Margins pitted for various distances from the beak. Upper valves flat with undulated margins.

Dimensions: Alt. 42 mm; Width 29 mm.

The form figured by Pilsbry and Brown shows two very angulate folds, but they note that some shells are flatter with less emphatic plications. One of our specimens has a strongly angulate margin but there are four or five instead of two folds. The other shells have about two folds but these are gentle.

Locality.—Near Usiacuri, Dept. of Atlantico.

Age.—Miocene.

Ostrea messor colombiensis Weisbord n. subsp. Pl. 2, figs. 8, 9

See Ostrea mesor Maury, Bull. Amer. Pal., Vol. 10, No. 42, P. 81, Pl. 10, Figs. 3, 4, 1925.

The left or lower valve is crescent-shaped with four of five angulate folds on the dorsal margin, three of which are more pronounced than the others. The surface of the valve has three or four weak, interrupted longitudinal folds. Beak curved, pointed. Resilium triangular, of moderate length. On either margin are narrow grooves extending part way down the shell and are pitted. The rest of the margin is simple. Muscular scars not deeply impressed. Upper valve missing.

Dimensions: Long. 53 mm; Width 33 mm.

This is like the foregoing but larger and thicker. It varies somewhat from the typical Trinidad *messor* in the arrangement of the angulations. Formerly this general group of shells was considered identical with the recent Peruvian *megodon* described by Hanley, but as Maury has pointed out Hanley's type has five or six larger folds and several posterior weaker ones. *O. messor caimites* from Santo Domingo is of the same general type as this species but has a thinner shell. *O. messor tabaquita* Maury and *O. megodon* Olsson are forms with occasional exaggerated saddles between the angulations.

Locality.—One-half kilometer west of Piedras de Afilar Dept. of Atlantico.

Age.—Miocene.

Collector.—Mr. C. C. Addison.

Superfamily PECTINACEA Reeve

Family PECTINIDÆ Lamarck

Genus AMUSIUM Bolten

Amusium luna Brown and Pilsbry Pl. 3, Fig. 1

Cf. Amusium Mortoni Böse, Inst. Geol. de Mexico, Boll. No. 22, P. 74, Pl. 1, figs. 3, 6, 7, 9; Pl. 8, Figs. 1, 2, 1906.

Pecten (Amusium) cf. mortoni Toula, Jahr. der K-K Geol. Reich., Vol. 58, P. 714, Pl. 26, Figs. 8, 9, 1908.

Pecten (Amusium) luna Brown and Pilsbry, Acad. Nat. Sci. Phil. Proc., Vol. 64, P. 514, Pl. 23, Fig. 1, 1912.

Amusium luna Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 205, Pl. 17, Fig. 1, 1922.

Amusium large species Cooke, U. S. Nat. Mus. Bull. 103, P. 588, 1919.

Altho considerably larger than the Canal Zone shell the Colombian specimen appears to be otherwise very similar. It is much like the East Coast *mortoni* but the latter is a broader form and the ears are separated from the disk by a light line. Unfortunately the interior of the hinge is inaccessible.

Locality.—Near Usiacuri, Dept of Atlantico.

Age.—Middle Miocene.

Distribution.—Canal Zone, Costa Rica, Venezuela and Colombia. The *mortoni* of Böse from Mexico may be referred to this species.

Family SPONDYLIDÆ Fleming

Genus SPONDYLUS Linné

Spondylus colombiensis Weisbord n. sp. Pl. 2, Figs. 10, 11

This species is represented in the collection by a well preserved right valve. Shell rather large, moderately convex, slightly inequilateral. Beak elevated, rather narrow, and twisted. Cardinal area prominent, about 12 mm. in altitude and 35 mm. in length, with a deeply incised, narrow, triangular resilium. Area marked with rather fine vertical striae. Ears subequal, the anterior sculptured with sinuous, transverse growth lines and crossed by radial lines giving the whole an imbricated appearance. The posterior ear only has the transverse striae. The valve is ornamented with seven or eight strong radii rather heavily spined. Between these are secondary smaller ribs, profusely studded with projecting spines, and a third and fourth series of riblets. The smallest are the most abundant and are also closely set with small rectangular nodes. On the other ribs the spines project downward and show a tendancy to be tubular.

Ventral margin well rounded; posteriorly the valve is slightly swollen. Inner margin with elongated denticles; muscular scar large. Interior of the shell chocolate colored.

Dimensions: Alt. 75 mm; Long. 65 mm.

The Colombian shell is closely allied to *S. falconensis* Harris[13] from Venezuela and *S. chiriquiensis* Olsson[14] from Costa Rica. The Venezuelan species has a greater number of larger, subequal secondary radii than the Colombian form has. With the exception of this slight variance in sculpture the two forms are strikingly similar. *S. chiriquensis* is also quite similar in its general characteristics but here again the stronger secondary radii and less spinose character of the tertiary threads serve to differentiate the two forms. The minor ribs on the well known *S. bostrychites* Guppy are less spiny than on *S. colombiensis.*

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[13] Bull. Amer. Pal., Vol. 13, No. 49, P. 40, Pl. 23, Figs. 4, 5, 1927

[14] Ibid, Vol. 9, No. 39, P. 206, Pl. 20, Figs. 1,2 5, 6, 1922.

Locality.—Near Tubera, Dept. of Atlantico.

Age.—Miocene.

Order ANOMALODESMACEA Dall

Superfamily ENSIPHONACEA Dall

Family POROMYACIDÆ Dall

Genus DERMATOMYA Dall

? Dermatomya harrisi n. sp. Pl. 3, Fig. 2

Shell large, plump, equivalved, somewhat inequilateral; shell substance rather thin. Anterior end slightly shorter, well rounded in front; posterior end longer, roundly truncate. Umbos large, high and plump. Beaks prosocoelous with a large, cordate, lunular depression in front. There is a slight line extending from the back of the beak part way down the valve. Before this, the valves have a very slight *Metis*-like depression. Valves marked with concentric growth striae which are more prominent near the margins of the valve. Ventral margin well rounded at the ends but nearly straight medially. Interior of the hinge not accessible.

Dimensions: Alt. 43 mm; Long. 52 mm.

The generic determination of this very interesting form is open to doubt. The typical *Dermatomya* has a thin, pearly shell, and those forms that have been described are small and characteristic of deep water. Nevertheless this has much in common with the *Poromyacidae* and until the characters of the hinge are known I am provisionally regarding this as *Dermatomya*[15]. In some of its aspects, however, the shell is like the genus *Thracia.*

This rare form is named in honor of Prof. G. D. Harris of Cornell University.

Locality.—Near Tubera, Dept. of Atlantico.

Age.—Middle Miocene.

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[15] Dall, U. S. Nat. Mus., Bull. 112, P. 27, Pl.3, Fig. 10, 1921

Order TELEODESMACEA Dall

Family CRASSATELLITIDÆ Dall

Genus CRASSATELLITES Kruger

Crassatellites reevei Gabb var. **pleurarostra** n. var. Pl. 3, figs. 3, 4

Crassatellites reevei Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 212, Pl. 20, Fig. 4, 1922. Not of Gabb?, Trans. Amer. Phil. Soc., Vol. 15, P. 252, 1873.

In 1873 Gabb collected a form of *Crassatellites* which resembles *antillarum* Reeve but for which he proposed the name *reevei.* Later Brown and Pilsbry[16] rediscribed and figured the Santo Domingan form noting in the description the fact that the concentric sculpture extends without irregularity upon the beak. In Costa Rica Olsson collected several forms which are nearly identical with *reevei* but have larger concentric waves on the beak. Upon comparison with Brown and Pilsbry's figure it appears, further, that the posterior angulation is not quite as deeply deflected as that of the Costa Rican form. For these two reasons the varietal name has been suggested.

The Colombian forms are in every way identical with the Costa Rican species.

Dimensions: Alt. 40 mm; Long. 57 mm.

C. trinitarius Maury[17] is a relatively more elongate form of this same general group. *C. trinitarius venezuelanus* Hodson[18] differs in being more pointed posteriorly altho this is a somewhat variable feature.

Localities.—Near Usiacuri; near Tubera; Morro Hermoso, in the Dept. of Atlantico.

Age.—Middle Miocene.

Distribution.—Colombia, Costa Rica.

Crassatellites aviaguensis ? F. Hodson Pl. 3, Figs. 5, 6

Crassatellites aviaguensis Hodson, Bull. Amer. Pal., Vol. 13, No. 49, P. 45, Pl. 28, Figs. 4, 7, 8, 10, 1927.

A large robust species with a wide hinge, big, deeply sunken lunule and strongly bent shell seems to be identical with the Venezuelan form, our shell is from the Miocene of the coastal Tertiary deposits. The Venezuelan species is reported to be from the Oligocene.

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[16] Acad. Nat. Sci. Phil. Proc., Vol. 64, P. 515, Pl. 23, Fig. 5, 1912.
[17] Bull. Amer. Pal., Vol. 10, No. 42, P. 175, Pl. 31, Figs. 1, 7, 1925.
[18] Ibid, Vol. 13, No. 49, P. 45, Pl. 28, Figs. 2, 6, 9, 1927.

Dimensions: Alt. 50 mm; Long. 65 mm.

The hinge on our form is 13 mm. in width. The lunule and escutcheon are decidedly sloping.

Locality.—Near Usiacuri, Dept. of Atlantico.

Age.—Middle Miocene.

Distribution.—Venezuela (Falcon) and Colombia (Atlantico).

Superfamily CARDITACEA Menke

Family CARDITIDÆ Gill

Genus VENERICARDIA Lamarck

Venericardia dominica new name Pl. 2, Fig. 12, Pl. 3, Figs. 10, 11; Pl. 4, Fig. 1.

Venericardia scabricostata Maury, Bull. Amer. Pal., Vol. 5, No. 29, P. 198, Pl. 33, Fig. 1, 1917. Not of Guppy, Quart. Journ. Geol. Soc. London, Vol. 22, P. 293, Pl. 18, Fig. 10, 1866.

Guppy's inadequate figure and brief description misled Maury in identifying a common Santo Domingan *Venericardia* with *Cardita scabricostata,* a Bowden species. This was later rectified by Woodring[19] who showed that the two species are distinct.

A number of Colombian specimens are practically identical with the Santo Domingan form. The shell is rather solid, subquadrate in outline, somewhat inequilateral, rather well inflated; anterior margin gently rounding into the slightly curved base; posterior margin nearly straight joining the base at an angle of about 65 or 70 degrees. Beaks high, plump. Sculpture consisting of about 18 to 21 high radial ribs bearing numerous equal transverse beads. The ribs are more strongly beaded on the anterior and medial portion of the shell than on the posterior truncation where the ribs are thinner than on the other part of the valve. The ribs are separated by interspaces as wide or wider than themselves. A series of fine thansverse growth striae are seen in the interspaces and are less prominent on the ribs. Hinge

[19] Carn. Inst. Wash. Pub. 366, P. 100, 101, Pl. 12, Figs. 7-9, 1925.

normal with the anterior cardinal tooth on the left valve split into two.

Dimensions: Alt. 23 mm; Long. 23 mm. Adult.

This differs from *Cardita scabricosta* Guppy from the Bowden beds of Jamaica by lacking the terraced ribs. "*Venericardia scabricosta*" Olsson[20] is quite similar but is plumper. *V. zuliana* Hodson[21] and its varieties are smaller forms of this same stock.

Locality.—Near Piedras de Afilar, Dept. of Atlantico.

Age.—Miocene.

Distribution.—Santo Domingo; Colombia.

Venericardia terryi Olsson Pl. 3, Figs. 7-9

Venericardia terryi Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 206, Pl. 32, figs. 12, 13.

The Colombian shell is somewhat larger but in other respects identical with the Costa Rican *V. terryi.* It is intermediate in size between *V. terryi* and *V. olssoni* Hodson[22] from Venezuela. *V. terryi* var. *brassica* Maury from the Brasso Miocene of Trinidad differs in being more elongate and in having more ribs.

Dimensions: Alt. 32 mm; Long. 30 mm.

Localities.—Near Tubera; near Usiacuri, in the Dept. of Atlantico.

Age.—Miocene.

Distribution.—Costa Rica; Colombia.

Superfamily CHAMACEA Geinitz

Family CHAMIDÆ Lamarck

Genus CHAMA (Linné) Bruguières

Chama corticosaformis n. sp. Pl. 4, Figs. 2-4

Shell large, thick, solid, lamellose, attached by the right valve. Right valve plump, quadrate in outline, sculptured with irregular lamellae which contain weak radial striae. Beak high, full, prosogyrate; hinge normal, with a prominent serrated tooth; ligamental groove rather long, narrow and deep. Visceral area of the valve smooth, the margin denticulate with numerous subequal striae. These become smaller toward the umbo; adductors rather deeply impressed.

Left valve smaller, flat, subcircular in outline, ornamented with numerous sharp irregular foliae which are adorned with radiating striae. Inner margin also denticulate.

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[20] Bull. Amer. Pal. Vol. 9, P. 388, Pl. 32, Figs. 14, 17, 1922.

[21] Ibid, Vol. 13, No. 49, P. 46, 1927.

[22] Bull. Amer. Pal., Vol. 13, No. 49, P. 49, Pl. 29, Figs. 13, 14, 1927.

Dimensions: Alt. 45 mm; Long. 42 mm. Right valve.
Alt. 37 mm; Long. 38 mm. Left valve.

This species is strikingly similar to the east coast Miocene *C. corticosa* Conrad, but differs in the uniformly greater solidity of the shell. It is also noted that *C. congregatoides* Maury from Santo Domingo is also closely allied to the East Coast *C. congregata* Conrad, making it appear as if the Caribbean Miocene Chamas have Atlantic affinities.

Localities.—Near Pto. Colombia; near Tubera, in the Dept. of Atlantico.

Age.—Miocene.

Distribution.—Colombia; Venezuela (Falcon).

Genus ECHINOCHAMA Fischer

Echinochama antiquata ? Dall Pl. 4, Fig. 5

Chama arcinella Guppy (not Linné), Quart. Journ. Geol. Soc., Vol. 22, P. 294, 1866.

Echinochama antiquata Dall, Wag. Inst. Sci. Trans., Vol. 3, Pt. 6, P. 1404, Pl. 54, Fig. 10, 1903.

Echinochama antiquata Woodring, Carn. Inst. Wash., Pub. 366, P. 106, Pl. 13, Figs. 1 - 4, 1925.

A broken left valve appears to be very similar to the Bowden species.

Locality. Near Tubera?, Dept. of Atlantico.

Age.—Miocene.

Distribution.—Bowden series of Jamaica; Falcon, Venezuela; Colombia?.

Superfamily CARDIACEA Lamarck

Family CARDIIDÆ Fischer

Genus CARDIUM Linné

Subgenus CERASTODERMA Morch

Cardium (Cerastoderma) brantlyi n. sp. Pl. 4, Fig. 7

Shell large, well inflated, rather thin, subcircular, with an extended well rounded anterior margin; subtruncate behind. Beak high, full. Sculptured with about 46 low, strong radial ribs, which are flattened near the umbos and a short distance down the valve, separated by slightly narrower square grooves which contain a rather wide, slightly depressed riblet which disappears toward the base. Ventrally the ribs become somewhat broader, more convex and are separated by simple, narrow, V-shaped interspaces. On the posterior fifth of the valve the ribs become nearly obsolete but can be seen if the outer layer of shell is worn. A series of light, shingle-like, concentric lamellae cross the whole. The ventral margin is broken.

Dimensions: Alt. 85 mm; Long. 77 mm; aproximately when whole.

This recalls the large *C. robustum* Solander in a general way but differs in having more numerous ribs and in being broader.

It is a pleasure to name this large rare species in honor of Mr. J. E. Brantly chief geologist of the Atlantic Refining Company.

Locality.—Morro Hermoso.

Age.—Miocene.

Subgenus LÆVICARDIUM Swainson

Cardium (Lævicardium) serratum Linnaeus Pl. 4, Fig. 6

Cardium serratum Linnaeus, Syst. Nat., Ed. 10, P. 680, 1758

Cardium (Lævicardium) serratum Dall, Wag. Inst. Sci. Trans., Vol. 3, Pt. 5, P. 1110, 1900.

Cardium (Lævicardium) serratum Brown and Pilsbry, Acad. Nat. Sci. Phil. Proc., Vol. 63, P. 367, 1911.

Cardium (Lævicardium) serratum Maury, Bull. Amer. Pal., Vol. 5, No. 29, P. 212, Pl. 36, Fig. 8, 1917.

Cardium cerratum Olsson, **Ibid**, Vol. 9, No. 39, P. 228, Pl. 27, Figs. 11, 12, 1922.

Cardium (Lævicardium) serratum Maury, **Ibid**, Vol. 10, No. 42, P. 138 Pl. 23, Fig. 14, 1925.

Cardium (Lævicardium) serratum Woodring, Carn. Inst. Wash. Publ. 366, P. 145, Pl. 19, Figs. 14 - 16, 1925.

A number of *Laevicardia* closely resemble the well known *serratum.* The Colombian form is characterized by a rather sharp posterior truncation and oblique form. This species varies considerably in obliquity, tumidity and clearness of radiating sculpture. Examination of a *Laevicardium* from Gatun which was called *Cardium* (*Levicardium*) *dalli* by Toula[23] shows no wide divergence from *serratum* and should perhaps properly be considered the same.

Locality.—Near Usiacuri, Dept. Atlantico.

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[23] Jahr. K-K Geol. Reich., Vol. 58, P. 722, Pl. 27, Fig. 6, 1908. Not of Heilprim, Trans. Wag. Inst. Sdi., Vol. 1, P. 131, Pl. 16a, Fig. 70, 1887.

Age.—Miocene.

Distribution.—Jamaica, Costa Rica, Canal Zone, Venezuela, Colombia, Trinidad, Florida, South Carolina.

Range.—Miocene.—Recent.

Dimensions: Alt. 43 mm: Long. 36 mm.

Superfamily VENERACEA Menke

Family VENERIDÆ Leach

Genus ANTIGONA Schumacher

Section DOSINA Gray

Antigona (Dosina) caribbeana Anderson Pl. 4, Fig. 12

Antigona multicosta Olsson (Not Sowerby), Bull. Amer. Pal., Vol. 9, No. 39, P. 239, Pl. 30, Fig. 1, 1922.

Antigona caribbeana Anderson, Cal. Acad. Sci. Proc., Vol. 16, No. 3, 4th ser., P. 90. Pls. 2, 3, 1927.

Antigona (Dosina) dominica Palmer, Paleont. Amer., Vol. 1, No. 5, P. 127, Pl. 29, Figs. 4, 7; Pl. 31, Fig. 15, 1927.

This species was first figured by Olsson who referred it to *multicostata* of Sowerby. Rather recently, however, Palmer recognized that the form is specifically distinct from that described by Sowerby and renamed it *dominica.* While her paper on the *Venericae* was in press, Anderson *op. cit.*, described and figured a large species from Colombia which he named *caribbeana.* This seems to be identical with *dominica* but inasmuch as Anderson's notification was published first, the name *dominica* is relegated to synonymy.

Our specimen tho considerably weathered is identifiable as *caribbeana.* It is characterized by its large size, square topped concentric ribs, and finely crenulated inner margin. *Antigona multicostata* Sowerby differs from the present species in having narrower and more rounded concentric costae.

Dimensions: Alt. 145 mm; Long. 125 mm.

Locality.—Usiacuri; Dept. of Atlantico, Colombia

Age.—Middle Upper Miocene.

Distribution.—Colombia—Usiacuri; Tubera.
Venezuela—La Vela? State of Falcon.
Costa Rica—Water Cay.
Santo Domingo—Rio Gurabo.

Genus CHIONE Megerle

Subgenus CHIONE Megerle

Chione (Chione) bolivarensis n. sp. Pl. 5, Figs. 2, 3

Shell of medium size, trigonally ovate in outline, considerably inflated or swollen. Beaks low, fairly prominent. Lunule slightly depressed, bounded by a rather deep groove and sculptured with about four prominent radiating riblets. Escutcheon broad. Posterior margin slightly convex or humped. Base arcuate. Somewhat behind the center of the valve is a very shallow but broad sulcus. Sculpture consisting of a number of concentric, lamellae which are inclined toward the umbos. These are separated by rather wide interspaces, in which, and on the ventral sides of the concentric lamellae are closely spaced, equal strong radii. On the anterior portion of the valve are three or four low, strong longitudinal ridges conforming with the natural curve of the shell extending from the anterior portion of the beak to near the base of the shell. Inner margin denticulate.

Dimensions: Alt. 20 mm; Long. 23 mm.

The main features are its strong inflation, posterior sulcus and longitudinally ribbed lunule. It superficially resembles the Venezuelan Miocene *C. paraguanensis* Hodson but differs in its stronger inflation, fewer concentric lamellae and ribbed lunule. From *C. sawkinsi* Woodring[24] it is distinguished by its broader escutcheon.

Locality.—Jesus del Monte, Dept. Bolivar.

Age.—Lower Middle Miocene.

Subgenus LIROPHORA Conrad

Chione (Lirophora) latilirata colombiana n. subsp. Pl. 4, Figs. 8 - 10

Shell rather large when adult, moderately inflated, thick, solid, rounded-trigonal in outline. Anterior margin bordering the lunule, very concave. Posterior margin nearly straight, base bounded by a slightly incised line; escutcheon rather broad. evenly arcuate. Lunule rather large, cordate, depressed, Sculpture in general resembling the *latilirata* type with a number of thickened, broad, semi-flattened ribs extending from the lunule to the escutcheon. There is no tendency for the ribs to play out posteriorly. The broader ribs are near the base of the shell gradually decreasing in size upward. Below the beak some specimens show a rib which is somewhat thicker than the immediate ones above and the first or first two below. Inner margin finely denticulate.

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[24] Carn. Inst. Wash. Pub. 366, P. 159, Pl. 21, Figs. 12-14, 1925.

Dimensions: Alt. 30 mm; Long. 36 mm. (Adult)

This species is of the same general type as the East Coast forms of *latilirata* which exhibit startling variations in the character and number of the ribs. *C. cartagenensis*[25] and *C. mataracana*[26] both described by H. K. Hodson are very similar species the former differing by having the ribs thin out near the escutcheon and being broader above than below, the latter differing in its less concave anterior margin bordering the lunule.

The distinguishing characters of this form are the persistant, regularly curved ribs which are generally broadest near the base, and the highly concave anterior margin.

Localities.—One half a kilometer W. of Piedras de Afilar; Morro Hermoso, Dept. Atlantico.

Age.—Miocene.

Collector.—Mr. C. C. Addison.

Chione (Lirophora) usiacurina n. sp. Pl. 4, Fig. 11

Shell of medium size, moderately convex medially, somewhat longer than high, with low, appressed beaks; lunule large, slightly sunken, bounded by a lightly impressed line which instead of being nicely curved is nearly straight centrally. Posterior margin slightly humped, base arcuate. The valve is sculptured with about 16 rather uneven, flexuous, rounded ribs which extend from near the border of the lunule to an area near the escutcheon where they flatten out. Escutcheon prominent, inclined. On the posterior fifth of the shell is a light longitudinal sulcus.

Dimensions: Alt. 23 mm; Long 28 mm.

The shell shows no radial sculpture on the surface. Its more characteristic features are the large lunule shaped somewhat like the hull of a ship, the flexuous ribs and the slightly humped posterior margin.

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[25] Bull. Amer. Pal., Vol. 13, No. 49, P. 63, Pl. 31, Fig. 4; Pl. 35, Fig. 6, 1927.

[26] Ibid, P. 64, Pl. 35, Fig. 4, 1927.

Locality.—Near Usiacuri, Dept. of Atlantico.

Age.—Miocene.

Genus CLEMENTIA Gray

Clementia dariena dariena Conrad Pl. 5, Fig. 1

Meretrix dariena Conrad, U. S. Pac. R. R. Expl. Vol. 5, Pt. 2, P. 328, Pl 6, Fig. 55, 1855.

Clementia (Clementia) dariena dariena Woodring, U. S. G. S. Prof. Paper 147 - C, P. 34, Pl. 14, Figs. 6 - 11, 1926.

A complete discussion including synonymy and distribution of this well known species is ably given by Woodring.

Dimensions: Alt. 60 mm; Long. 55 mm.

Localities.—10 kil. W. of Usiacuri; 1 kil. E. of Usiacuri, Dept. of Atlantico.

SuperFamily TELLINACEA Blainville

Family TELLINIDÆ Deshayes

Genus METIS H. & A. Adams

Metis trinitaria colombiensis n. subsp. Pl. 5, Fig. 6

Shell oval-oblong, anterior end rounded, posterior end slightly longer or of equal length. Right valve with a broad sulcus extending from the umbo in a slightly oblique line to the base of the shell gradually expanding ventrally. This is bounded posteriorly by a well defined ridge with a faint suggestion of a fainter one in front. Surface sculptured with numerous, fine, slightly elevated, concentric lines. Beaks situated at or near the center. Left valve with a gradually expanding ridge behind the beak.

Dimensions: Alt. 46 mm; Long. 60 mm.

This is very similar to *M. trinitaria*[27] Dall. The Colombian shell, however, seems to differ in having the beaks located centrally, making the anterior and posterior parts of the shell nearly equal in length. On the Trinidad form the anterior end is somewhat produced.

Locality.—Near Usiacuri, Dept. of Atlantico.

Age.—Miocene.

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[27] Wag. Inst. Sci. Trans., Vol. 3, Pt. 5, P. 1041, Pl. 46, Fig. 24, 1900.

Family PSAMMOBIIDÆ Dall

Genus ASAPHIS Modeer

Asaphis delicatus (Weisbord) Pl. 5, Figs. 4, 5

Asaphis delicatus Weisbord, Pal Venezuela, P. 210, Pl. 17, Fig. 14, 1924. (MS)

A poorly preserved specimen from Colombia seems to be identical with *Asaphis delicatus* first described from Venezuela For the sake of clarity the following description is taken from the Venezuelan specimen which is in a good state of preservation.

Shell large, thin, ovate, moderately convex, produced behind with a slightly truncated posterior dorsal area; base nearly straight; umbos conspicuous, quite convex, with prominent subacute beaks situated on the anterior third of the shell. Sculpture consisting of a series of delicate, wavy, radii with one or more finer threads between. In addition there are fine concentric lines and concentric undulations. These are more prominent near the margins of the valve. Interior inaccessible.

Dimensions: Venezuelan shell — Alt. 42 mm; Long. 59 mm.
Colombian shell — Alt. 42 mm; Approx. Long. 56 mm.

This species recalls *A. centenaris* Conrad from the East Coast Miocene, but the latter is more coarsely sculptured radially, and also has numerous concentric incremental lines transversing the whole, giving a more rugged appearance to the shell. Nevertheless the relationship between the two species is rather marked.

Localities.—N. of Urumaco, Falcon, Venezuela.
Near Usiacuri, Atlantico, Colombia.

Age.—Middle Miocene.

Superfamily MYACEA Menke

Family CORBULIDÆ Fleming

Genus CORBULA Lamarck

Subgenus CUNEOCORBULA Cossmann

Corbula (Cuneocorbula) hexacyma Brown and Pilsbry Pl. 5, Figs. 7 - 9

Corbula (Cuneocorbula) hexacyma Brown and Pilsbry, Acad. Nat. Sci. Phil. Proc., Vol. 64, P. 518, Pl. 26, Fig. 4, 1912.
Corbula hexacyma Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 269, Pl. 21, Figs. 12, 13, 1922.

The species is characterized by its solidity and wave-like concentric ribs. In addition there are fine, hair-like, radial threads which may be observed on perfect specimens.

Dimensions: Alt. 13 mm; Long. 18 mm.

On the majority of the Colombian specimens the radial striae are obsolete. *C. guaiconensis* Maury from the Machapoorie of Trinidad is a smaller form of the same typé.

Locality.—E. of Esperanza, Dept. of Bolivar.

Age.—Middle Miocene.

Class SCAPHOPODA Bronn

Family DENTALIIDÆ Gray

Genus DENTALIUM Linné

Dentalium (Fissidentalum ?) solidissimum Pilsbry and Brown, Pl. 5, Figs. 10, 11

Dentalium solidissimum Pilsbry and Brown, Acad. Nat. Sci. Phil. Proc., Vol. 69, P. 37, Pl. 5, Fig. 8, 1917.

This species attains a large size. The shell is slowly tapering, slightly curved and almost circular in section at the smaller and larger ends. Near, but not quite at the tip, there are about 10 or 11 thin, elevated, longitudinal ribs separated by much wider interspaces. By intercalation, this number shortly increases to about 28. For a distance of about three centimeters from the tip, the longitudinal ribs are elevated, rounded and separateed by at first wider, then equal and finally much narrower interspaces. In addition the shell is covered by a series of rather prominent, equal, revolving striae, which become obsolete near the larger portion of the tube. Finally the ribs become subequal, low, broad, very slightly rounded and separated by narrow, shallow grooves. Occasionally there is one, or a few interstitial, irregularly sized ribs. The revolving striae have disappeared. The shell is very thick, being somewhat over two milimeters near the larger end.

Dimensions: Approximate total length 150 mm;
Width at smaller end ...... 1½ mm.
Width at larger end ...... 14 mm.

This species is characterized by its thick shell, circular cross section and in addition to the regular series of longitudinal ribs, the secondary sculpture of revolving striae. It closely resembles *D. rimosum* Böse[28] from the Isthmus of Tehuantepec, Mexico, but comparison with a specimen of the latter shows it to have longitudinally bifurcated ribs. This feature is not present on the Colombian forms.

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[28] Inst. Geo. de Mexico, Vol. 22, P. 55, Pl. 3, Fig. 1, 1906.

Localities.—Near Tubera; near Pto. Colombia, Dept. of Atlantico.

Age.—Miocene.

Collector.—Mr. C. C. Addison.

Class GASTROPODA Cuvier

Order CTENOBRANCHIATA Schweigger

Superfamily PTENOGLOSSA Gray

Family SOLARIIDÆ Chenu.

Genus ARCHITECTONICA Bolten

Architectonica granulatum (Lamarck) Pl. 9, Fig. 15

Solarium granulatum Lamarck, An. sans. Vert., Vol. 7, P. 3, 1792. Ency. Method, Pl. 446, Figs. 5a, b, 1792.
Solarium granulatum Dall, Wag. Inst. Sci. Trans., Vol. 3, P. 329, 1892.
Solarium Villarelloi Bose, Inst. Geol. Mexico, No. 22, P. 30, Pl. 3, Figs. 4 - 11, 1906
Solarium gratunense Toula, Jahr. K-K Geol. Reich., Vol. 58, P. 692, Pl. 25, Fig. 3, 1908.
Solarium granulatum Maury, Bull. Amer. Pal., Vol. 5, No. 29, P. 131, Pl. 23, Fig. 3, 1917.
Architectonica Gratunensis Cooke, U. S. Nat. Mus. Bull. 103, P. 588, 1919.
Architectonica granulata Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 154, Pl. 13, Figs. 10 - 12, 1922.
Architectonica granulata Maury, **Ibid**, Vol. 10, No. 42, P. 236, Pl. 40, Fig. 1, 1925.
Architectonica gratunensis Anderson, Calif. Acad. Sci. Proc., Vol. 16, No. 3, P. 89, 1927.
Architectonica granulata Hodson and Harris, Bull. Amer. Pal., Vol. 13, No. 49, P. 66, Pl. 36, Fig. 7, 1927.

Comparison with the recent *granulatum* shows the fossil form to be practically identical. The width and granulation of the spiral cords vary on different specimens. *A. villarelloi* Böse from the Miocene of Mexico and *A. gatunensis* Toula from the Canal Zone appear to be synonymous forms. *A. quadriseriata* Sowerby is a finely beaded species of the same type. This has a wide areal extent.

Dimensions: Width 20 mm; Alt. 14 mm.
Width 40 mm; Alt. 22 mm.

Localities.—Near Usiacuri, Dept. of Atlantico; E. of Esperanza, Dept. of Bolivar.

Age.—Lower Middle - Middle Miocene in Colombia.

Distribution.—Lower and Upper Miocene of the East Coast; Miocene of San Domingo, Canal Zone, Costa Rica, Venezuela, Colombia, Trinidad; recent in the Antilles.

Range.— Lower Miocene to Recent.

Superfamily TÆNIOGLOSSA Bouvier

Family NATICIDÆ Forbes

Genus NATICA Scopoli

Natica canrena (Linné) Morch Pl. 9, Fig. 13

Natica canrena (Linné, partim) Moerch, Malak, Blatt. 24, P. 62, 1877
Natica canrena Dall, Wag. Inst. Sci. Trans., Vol. 3, P. 364, 1892
Natica canrena Brown and Pilsbry, Acad. Nat. Sci. Phil. Proc., Vol. 64, P. 508, 1912.
Natica canrena Maury, Bull. Amer. Pal., Vol. 5, P. 298, Pl. 49, Fig. 10, 1917.
Natica canrena Olsson, Ibid. Vol. 9, P. 327, Pl. 16, Fig. 9, 1922.
Natica canrena Maury, Ibid. Vol. 10, P. 390, Pl. 40, Fig. 8, 1925.
Natica canrina Hodson and Harris, Ibid. Vol. 13, No. 49, P. 68, 1927.

This species is characterized by its deep notch, excavated umbilical callus, and strong, tangential sutural plicae. It is a widespread form geographically and ranges from Oligocene to recent.

Dimensions: Alt. 25 mm; Width 22 mm.

Locality.—Between Sibarco and Piedras de Afilar; Morro Hermoso, Dept. Atlantico.

Distribution.—Miocene of the East Coast, Canal Zone, Costa Rica, Jamaica, Trinidad, Venezuela, Colombia, living in the Antilles as far south as Pernambuco.

Natica cuspidata Guppy Pl. 9, Fig. 14

Natica cuspidata Guppy, Agr. Soc. Trinidad and Tobago, Paper No. 454, P. 5, Pl. 2, Fig. 4, 1910. Harris reprint, Bull. Amer. Pal. No. 35, P. 162, Pl. 8, Fig. 4, 1921.
Natica cuspidata Maury, Bull. Amer. Pal., Vol. 10, No. 42, P. 239, Pl. 40, Figs. 9, 10, 1925.
Natica cuspidata Anderson, Calif., Acad. Sci. Proc., Vol. 16, No. 3, P. 89, 1927.

A large sigaretiform Natica is probably equivalent to the Trinidad Miocene *cuspidata* described by Guppy. Our shell is identical with the specimen figured under number nine in Dr. Maury's contribution to the Miocene of Trinidad (see above).

Dimensions: Alt. 35 mm; Width 56 mm.

The Venezuelan analogue is the robust *N. subporcana* (Williston) Hodson[31]. Flattened specimens of the latter are nearly identical with the present species.

Locality.—Near Usiacuri; near Tuberá (Anderson), Dept. of Atlantico.

Age.—Miocene.

Distribution.—Trinidad—Springvale Miocene; Colombia.

Genus POLINICES Montfort

Polinices (Mammilla) cf. brunnea Linck Pl. 9, Fig. 12

Mammilla brunnea Linck, Beschr. Rostock Samm., P. 140, 1807.
Natica mammillaris Lamarck, An. sans. Vert., Vol. 6, P. 197, 1822.
Natica mammillaris Tryon, Manual, P. 43, Pl. 18, Fig. 74, 1886.
Polinices brunnea Dall, U. S. Nat. Mus. Bull. 37, P. 156, 1889.
Polinices mammillaris Pilsbry and Brown, Acad. Nat. Sci. Phil., Vol. 69, P. 34, 1917.
Polinices (Mammilla) brunnea Maury, Bull. Amer. Pal., Vol. 9, P. 150, 1922,

A number of rather large weathered forms are very closely allied if not identical with the recent *P. brunnea* commonly known as *P. mammillaris.* The shell is ovate with about five evenly convex whorls separated by lightly defined sutures. Spire mamillate. Body whorl very slightly flattened near the suture, well rounded below. Aperture ovate. Inner lip grooved horizontally just above the umbilicus.

Dimensions: Alt. 35 mm; Width 29 mm.

This at once recalls the Miocene *P. subclausa* Sowerby but differs in being larger and relatively broader. It is also closely akin to the Venezuelan *P. subclausa lavelena* Hodson[31] but none of our specimens show the deep notch adjacent to the umbilicus. In other respects however the two forms are very similar.

Localities.—Near Tuberá; near Puerto Colombia, Dept. of Atlantico.

Age.—Miocene.

Distribution.—Miocene of Colombia; recent from Florida Keys to Trinidad.

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[31] Bull. Amer. Pal., Vol. 13, No. 49, P. 69, Fig. 8; Pl. 37, Figs. 12, 14, 1927.

Family TURRITELLIDÆ Gray

Genus TURRITELLA Lamarck

Turritella cartagenensis Brown and Pilsbry Pl. 9, Figs. 1, 2

Turritella cartagenensis Brown and Pilsbry, Acad. Nat. Sci. Phil., Vol. 69, P. 34, Pl. 5, Fig. 13, 1917.
Turritella cartagenensis Hodson, Bull. Amer. Pal., No. 45, P. 49, 1927.

This species attains a large size. The earlier whorls are flat-sided or slightly convex and ruled with unequal, low but strong striae. The later whorls are somewhat concave with a slight swelling on some specimens above and below the well incised suture. The base is also ornamented with revolving striae but the number and character vary. Only occasionally have I seen specimens which show "four very low, wide spiral welts" as described by Brown and Pilsbry. Sometimes the base has subequal threads, sometimes unequal threads, and occasionally larger and smaller threads interspaced.

Dimensions: Alt. 70 mm; Width 22 mm; (Six and a half basal whorls).

In the Miocene series of Venezuela there is a very simiiar form to this which Hodson has called *T. bifastigata* var.*democraciana* and *maracaibensis.* The whorls on *democraciana* are separated by gaping sutures, while the whorls on the latter have very pronounced but compressed swellings on both sides of the suture. The typical *T. bifastigata* Nelson from Peru is also rather closely allied but differs substantially in having coarse strong revolving cords on the base of the shell.

Localities.—Near Usiacuri; near Tuberá, Dept. of Atlantico; near Cartagena, Dept. of Bolivar.

Age.—Miocene.

Turritella supraconcava Hanna and Israelsky var. **fredeai** Hodson
Pl. 9, Figs. 3, 4

Turritella robusta Grzybowski fredeai Hodson, Bull. Amer. Pal., Vol. 11, No. 42, P. 183, Pl. 5, Figs. 1, 3 etc., 1927.
Turritella abrupta Anderson, Cal. Acad. Sci. Proc., Vol. 16, No. 3, P. 89, 1927

Both this and the Venezuelan shell are closely allied to the Peruvian *T. robusta* Grzybowski. Inasmuch as the name *robusta* is preoccupied the name was changed to *supraconcava* by Hanna and Israelsky[32]. The Colombian species differs from the true

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[32] Calif. Acad. Sci. Proc., 4th ser., Vol. 14, P. 59, 1925.

supraconcava by having fewer revolving threads above the sharp keel.

Dimensions: Alt. 55 mm; Width 21 mm; Six and a half whorls.

The Colombian species at times varies slightly in some of the sculptured details from the Venezuelan species but inasmuch as there is a tendancy for variation among the Colombian specimens themselves I have deemed it advisable not to consider it as a variety. *Turritella bosei* Hertlein & E. K. Jordan[33] from Lower California is of the same general type.

Localities.—Near Usiacuri, Dept. of Atlantico; E. of Esperanza, Dept. Bolivar.

Age.—Miocene.

Distribution.—Colombia; Venezuela; Panama.

Turritella cf. **falconensis** (Williston) Hodson Pl. 9, Fig. 10

Turritella falconensis Williston, Pal. Falcon, Pl. 1, Figs. 10-12, 1923, (MS).
Turritella falconensis Weisbord, Pal. Venezuela, P. 271, Pl. 3, Fig. 8, 1924, (MS).
Turritella gilbertharrisi falconensis Hodson, Bull. Amer. Pal., Vol. 11, No. 45, P. 19, Pl. 14, Figs. 2, 6, 8, etc., 1927.

A number of broken and weathered specimens have the following characteristics. Shell probably of large size when adult, moderately tapering. The whorls which are separated by barely discernible sutures are composed of four major, obliquely beaded spiral cords, the bottommost of which is slightly more protuberant than the others; this is just above the suture and is obsoletely ornamented with fine spiral threads and very faint beads; above this are three subequally spaced cords of which the middle is the weakest, the ones above and below of equal prominence. These three are somewhat more prominently beaded than the lowermost cord. Above the uppermost cord is another revolving line just slightly stronger than the series of fine threads that appear between the major ones. On larger whorls there are two of these.

Dimensions: Alt. 25 mm; Width 15 mm; four middle whorls.

The arrangement of the ribbing is practically identical to that of the Venezuelan specimens, but they are not quite as rugged. This, however, I believe may be due to weathering and for this reason I am provisionally considering the Venezuelan and Colombian forms identical. The Venezuelan shell is a long, robust species with sharply corded whorls. The upper whorls however are less prominently sculptured and in this respect are similar to those on the Colombian specimens.

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[33] **Ibid,** Vol. 16, No. 19, P. 634, Pl. 21, Figs. 1, 2, 1927.

Localities.—E. of Esperanza, Dept. of Bolivar.

Age.—Lower Middle Miocene.

Distribution.—Venezuela—States of Lara, Zulia and Falcon; Colombia.

Turritella vistana colombiana n. subsp. Pl. 8, Fig. 14; Pl. 9, Fig. 11

Shell very long, gradually tapering; whorls numerous, ornamented with two very high, single, beaded spiral ribs; on the later whorls the elevated cord on the upper fourth of the whorl is slightly thicker and somewhat more protruding than the lower, and is sculptured with oblique nodes, the nodes on the latter being weaker, and oriented oppositely to those of the one above. In the deep, wide, concave interval between the ribs are several, fine, slightly beaded striae occasionally overrun by sinuous growth marks. The portion of the whorl below the lower primary rib is slightly concave and somewhat protrudes over the narrow, incised suture.

Dimensions: Alt. 57 mm; Width 10 mm; (Upper 11 whorls).

This is very similar to *T. vistana* Hodson from Venezuela and similar forms of the *altilira* group. It differs from *vistana* in constantly having more numerous and finer secondary revolving threads. Otherwise the two forms are identical. The same holds true for *T. altilira* var. *urumacoensis* also from Venezuela. *T. altilira* var. *nicholsi* differs from the present species in having more elevated ribs which are frequently bent.

Localities.—Near Tubera; Puerto Colombia; Morro Hermoso, in the Dept. of Atlantico.

Age.—Miocene.

Turritella altilira Conrad **var. atlanticensis n. var.** Pl. 9, fig. 9

This *Turritella* is locally very abundant. The shell is long, slender, and gently tapering. The earlier whorls have two elevated, rounded cords on the lower and upper quarter separated by a shallow, concave interspace with two secondary striae. On later whorls, the elevated cords become pronounced, and the upper is frequently but not always slightly thicker than the lower. Just below the edge of the upper whorl there is frequently a rather strong, beaded secondary thread followed by two or sometimes three unequal threads in the interspace. Sometimes the uppermost secondary cord is the strongest, but more rarely the uppermost and lowermost secondary threads are of equal strength with a weaker thread in between. Below the lower primary rib the whorl is sharply concave and somewhat overhangs the incised suture. The primary ribs are sculptured with fine revolving striae and slender, oblique nodes.

Dimensions: Alt. 35 mm; Width 10 mm; 7 middle whorls

This species differs from the foregoing in the character of the interstitial threads. On *T. vistana colombiana* the secondary threads are finer and more numerous, and it does not have the upper primary cord bordered by a rather strong secondary one. From the typical *altilira* this species may be differentiated by its more recessive and weaker secondary cord adjacent to the primary. It is close to *T. altilira urumacoensis* Hodson[34] from Venezuela but the whorls of this species more prominently overhang the suture and differ somewhat in the details of the secondary sculpture.

Locality.—Between Las Perdices and Pto. Colombia, Dept. of Atlantico.

Age.—Miocene

Turritella cf. gatunensis Conrad **Pl. 9, Fig. 7**

Turritella gatunensis Conrad, Pac. R. R. Rep., VI, P. 72, Pl. 5, Fig. 20.
Turritella conradi Toula, Jahr. K-K Geol. Reich., Vol. 58, P. 694, Pl. 25, Fig. 4, 1908
Turritella gatunensis Brown and Pilsbry, Acad. Nat. Sci. Phil. Proc., Vol. 63, P. 358, Pl. 27, Figs. 4, 5, 9. 1911.
Turritella gatunensis Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 143, Pl. 14, Figs. 12, 13, 1922.
Turritella gatunensis Maury, Ibid. Vol. 10, No. 42, P. 229, Pl. 42, Fig. 12, 1925.

A few fragmentary, weathered specimens are seemingly identical with figures and occasional specimens from the Canal Zone. The Colombian specimens are nearly identical to the varietal Venezuelan form *lavelana*[35] but inasmuch as there is some variation in the sculptural details of the typical *gatunensis* from the vicinity of the type locality, I consider such slight variations as natural mutations of the same species.

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[34] Bull. Amer. Pal., Vol. 11, No. 45, P. 44, Pl. 26, Figs. 4, 7, etc., 1927.

[35] Hodson, Bull. Amer. Pal., Vol. 11, No. 45, P. 23, Pl. 18, Fig. 6; Pl. 19, Fig. 7, 1926.

Dimensions: Alt. 22 mm; Width 11 mm; 3½ lower whorls.

Localities.—E. of Esperanza, Dept. of Bolivar.

Age.—Miocene.

Distribution.—Colombia—Dept. Bolivar.
Venezuela—State of Falcon.
Panama—Canal Zone; Water Cay.
Costa Rica—Boucary Creek.
Trinidad—Brasso Creek.

Turritella cf. gatunensis taratarana Hodson Pl. 9, Fig. 8.

Turritella gatunensis Conrad taratarana Hodson, Bull. Amer. Pal., Vol. 11, No. 45, P. 25, Pl. 18, Figs. 5, 7, 1926.

A few of the broken Colombian specimens are identical with Hodson's specimen, figure 7. Some of the others vary slightly in the arrangement of the spiral threads but all the forms are of the same stock.

The species is characterized by the excavated sutural zones, and profusely threaded whorls. The whorls are slightly concave medially; below they are rounded, and above they are flat and tapering. The base of the upper whorl protrudes beyond the upper part of the succeeding whorl. The shell is sculptured with subequal and unequal revolving threads which are often scalloped or beaded. This is generally confined to the larger threads of which there are three on a whorl. The basal one comes just above the base of the whorl and this is somewhat stronger than the upper pair at the top of the whorl. Of these, the uppermost may be slightly weaker and may form a slight keel. Minor threads are dispersed throughout.

Dimensions: Alt. 19 mm; Width 9 mm; 3 lower whorls.

Locality.—Between Las Perdices and Pto. Colombea, Dept. of Atlantico.

Age.—Miocene.

Turritella lloydsmithi Pilsbry and Brown Pl. 9, Figs. 5, 6.

Turritella lloydsmithi Pilsbry and Brown Acad. Nat. Sci. Phil. Proc., Vol. 63, P. 35, Pl. 5, Fig. 11, 1917.

The earlier whorls are of the *planigirata* type with a medial, rather thick carina. Below this the whorl is slightly concave with a prominent revolving cord between the carina and the suture. The upper part of the whorl is flat or slightly convex, tapering, and sculptured with two subequal striae. Starting with the fifth or sixth whorl, the medial keel becomes sharper-edged but not quite as prominent; the concavity below becomes somewhat more pronounced with a medial cord which is slightly stronger than the finer threads above and below. At the base of the whorl just above the narrowly incised suture there is a thickened, somewhat protuberant rib with a few obsolete revolving striae on it. The upper part of the whorl has numerous, rather unequal revolving threads with a somewhat stronger one medially. As growth progresses, the whorl becomes more uniform and is sculptured with five to seven prominent, rounded ribs the basal one of which is larger than the others. The lower ribs are stronger than the more closely spaced upper ones. Over all there are finer subequal revolving threads.

Approaching the base, the whorl projects beyond the upper part of the succeeding lower whorl. The base is convex with about six strong revolving cords and smaller secondary striae.

Dimensions: Alt. 30 mm; Width 12 mm; Upper 12 whorls.
Alt. 42 mm; Width 21 mm; Lower 3 whorls.

This species differs from *T. planigyrata* Guppy from Trinidad in having more prominent revolving cords and in having a stronger shell. *T. trinitaria* Maury also from Trinidad is very similar but its whorls are more convex, and have more irregular spiral cords with obsolete secondary threads. The group of forms listed under *berjadinensis*[36] from Venezuela are of the same stock but differ in sculptured details. *T. Mimetes* Brown and Pilsbry[37] is quite similar but differs in sculptural details.

Localities.— Near Usiacuri; near Tuberá; Piedras de Afilar, Dept. Atlantico.

Age.—Middle Miocene.

Distribution.—Depts. Atlantico, Bolivar.

Family VERMETIDÆ Adams

Genus SERPULORBIS Sassi

Serpulorbis papulosus? Guppy Pl. 8, Fig. 13.

Vermetus papulosa Guppy, Ibid, Vol. 32, P. 519, 1876.
Fig. 3, 1866.
Vermetus papulosa Guppy, Ibid, Vol. 32, P. 519, 1876.

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[36] Hodson, Bull. Amer. Pal., Vol. 11, No. 45, P. 26, Pl. 19 etc., 1927.
[37] Acad. Nat. Sci. Phil. Proc., Vol. 63, P. 357, Pl.27, Fig. 1.

Serpulorbis papulosa, Maury, Bull. Amer. Pal., Vol. 5, P. 291, Pl. 22, Fig. 10, 1917.
Serpulorbis papulosa Olsson, Ibid, Vol. 9, No. 39, P. 145, Pl. 12, Fig. 1, 1922.
Serpulorbis papulosa Anderson, Calif. Acad. Nat. Sci. Proc., 4th ser., Vol. 16, No. 3, P. 89, 1927.

Several fragments are probably referable to this species. On the larger specimen, which is considerably weathered are a series of obtuse nodes and slight transverse swellings and constrictions. The finer sculpture has been removed. On the smaller specimen there is a series of longitudinal nodose ribs interlined with three or four subequal crenate striae.

Localities.—Between Las Perdices and Pto. Colombia; near Tubera, Dept. of Atlantico.

Age.—Miocene.

Distribution.—Jamaica—Bowden series.
Santo Domingo—Gurabo series.
Costa Rica—Gatun stage.

Genus PETALOCONCHUS H. C. Lea

Petaloconchus domingensis Sowerby Pl. 8, Fig. 15.

Petaloconchus domingensis Sowerby, Quart. Journ. Geol. Soc., Vol. 5, P. 51, Pl. 10, Figs. 9a, b, c, 1849.
Vermetus (Petaloconchus) sculpturatus Dall, Wag. Inst. Sci., Trans., Vol. 3, P. 305, 1892.
Petaloconchus domingensis Pilsbry and Brown, Acad. Nat. Sci. Phil., Proc., Vol. 63, P. 359, 1911.
Petaloconchus domingensis Maury, Bull. Amer. Pal., Vol. 5, No. 29, P. 128, Pl. 22, Fig. 11, 1917.
Petaloconchus domingensis Hubbard, N. Y. Acad. Sci., Vol. 3, Pt. 2, P. 139, 1921.
Petaloconchus sculpturatus Olsson, Bull. Amer. Pal., Vol. 9, No. 39, P. 146, Pl. 14, Figs. 10, 15, 1922.
Petaloconchus domingensis Anderson, Cal. Acad. Sci. Proc., 4th ser., Vol. 16, No. 3, P. 89, 1927.

Only a partial synonymy has been listed above.

The transverse growth lines are numerous on the Colombian specimens. Excellent authorities regard this species as *sculpturatus* H. C. Lea but the writer is inclined to retain the name *domingensis*. The species is closely allied to *P. alcinus* Mansfield[38].

Localities.—Tubera; near Pto. Colombia; near Piedras de Afilar, Dept. Atlantico.

Age.—Miocene.

[38] U. S. Nat. Mus. Proc., Vol. 66, Art. 22, P. 51, Pl. 9, Figs. 2-4, 1925.

Distribution.—Colombia—Dept. Atlantico, Bolivar.
Venezuela—State of Falcon.
Jamaica—Bowden series.
Costa Rica—Gatun stage, Banana River.
San Domingo—Gurabo formation.
Trinidad—Springvale formation.
Porto Rico—Quebradillas limestone.
Mexico—Tuxtepec.

Family CERITHIIDÆ Menke

Genus POTAMIDES Brong.

Potamides avus Pilsbry and Brown Pl. 8, Figs. 10 - 12

Potamides avus Pilsbry and Brown, Acad. Nat. Sci. Phil. Proc. Vol. 69, P. 34, Pl. 5, Fig. 5, 1917.

Shell of medium size; spire high, rather acutely tapering; whorls about ten, increasing rapidly in size. Whorls carinate medially or submedially, ornamented with 11 to 13 short, pointed nodes on young specimens. Adult forms have from eight to ten nodes. Above this series of coronal tubercles, the whorls are concave, below they are convex on the early whorls, but flat and sloping inward on the later ones. The shell is weakly or strongly striate spirally. On better preserved specimens the penultimate whorl shows a lightly beaded revolving thread about half way between the nodes and the suture. This thread is somewhat more pronounced than the other spirals. The sutures are weakly incised with an occasional pseudo-subsutural band. Body whorl convex above with two stronger spiral cords, one at about the middle, the other a short distance below. Mouth roundly quadrate, small. Anterior canal short, narrow, flexed.

Dimensions: Alt. 30. mm; Width 15 mm.

The specimen figured by Brown and Pilsbry is an adult form. The majority of the specimens in our collection are not quite as fully developed. These have more numerous tubercles than the older ones.

Locality.—Cedral, Dept. of Atlantico.

Age.—Miocene.

Potamides maracaibensis (Willston) Pl. 8, Figs. 8, 9

Potamides maracaibensis Williston, Pal. Falcon, Pl. 8, Fig. 5, 1923. (MS)
Potamides maracaibensis Weisbord. Pal. Venezuela, P. 284, Pl. 4, Figs. 19 - 21, 1924. (MS)

Shell of moderate size, prominently turreted; spire high, about one-half the total length of the shell in size. Whorls about seven, the post-nuclear three or four convex, sculptured with unequal spiral threads. On the third whorl from the last the spiral lines are confined to the upper portion and become obsolete or faint below; the following volutions acquire a series of about six rather sharp nodes which on the shoulder of the whorl are pointed, but have a marked tendency to merge into a Nassa-like fold below the angle. The spiral sculpture is confined to the upper part of the volution. The body whorl is broadly convex above, constricted below. There are some light spiral lines on the medial portion which become more closely spaced and stronger anteriorly. The mouth parts on the Colombian specimens are obscured but on the Venezuelan forms the outer lip is plain, the aperture fairly broad and constricted below into a sinuous anterior canal.

Dimensions: Alt. 39 mm; Width 20 mm.

Locality.—Between Las Perdices and Pto. Colombia, Dept. of Atlantico.

Age.—Miocene.

Distribution.—Venezuela—Urumaco, Falcon. Colombia.

Subgenus LAMPANELLA Moerch

Potamides (Lampanella) ormei Maury Pl. 8, Figs. 6, 7.

Cf. Cerithium suprasulcatus Gabb, Trans. Amer. Phil. Soc., Vol. 15, P. 237, 1873.
Potamides ormei Maury, Bull. Amer. Pal., Vol. 5, P. 290, Pl. 22, Fig. 8, 1917.
Potamides suprasulcatus Pilsbry (partim), Acad. Nat. Sci. Proc., Vol. 73, P. 373, Pl. 29, Fig. 10, 1921.

This sturdy form is characterized by the three rows of heavily noded spiral bands and transverse, slightly arcuate folds. The upper spiral cord is somewhat larger than on the lower two, and below it there is a fairly deep interspace. The body whorl has one or two lightly beaded riblets below the strong subsutural cord. Below these there are about eight, simple subequal revolving lines. The outer lip on all the specimens is broken but it is probably somewhat flaring. The columella is not plicate. Anterior canal short, twisted. There are probably about ten whorls in complete specimens.

Dimensions: Alt. 33 mm; Width 16 mm. (Approximate for whole specimen).

One of our specimens shows the body whorl with four flexuous transverse growth folds. Comparison with the Peruvian *P. ormei* var. *infraliratus* Spieker[39] shows it to be nearly identical except for the blunt anterior canal of the Zorritos species. *P. gastrodon* Pilsbry and Johnson[40] is strikingly similar but possesses a columellar fold.

P. suprasulcatus as figured by Pilsbry (*op. cit.*) under figure ten is undoubtedly the species under discussion. But whether this is the *suprasulcatus* of Gabb I am not assured. None of our Colombian specimens or others in the collection from Santo Domingo in the laboratory are as simply sculptured as that figured under figure 11 by Pilsbry. This may be due to the lack of weathering on our specimens but in the absence of such I prefer to retain Maury's name. *P. transecta* Dall from the Tampa Silex beds of Florida is also of the same type.

Locality.—E. of Esperanza, Dept. of Bolivar.

Age.—Miocene.

Distribution.—Santo Domingo; Colombia.

Subgenus PYRAZISINUS Heilprin

Potamides (Pyrazisinus) bolivarensis n. sp. Pl. 8, Fig. 5.

Shell rather large, with about 13 whorls when complete. There are five strong, flat, spiral bands wider than their interspaces running over strong subequal axial folds. Of the latter there are about 13 on a whorl. Occasionally one of these folds becomes larger than the others, and on the penultimate volution all folds become considerably stronger. The uppermost spiral band is separated by a slightly wider interspace than the remaining four.

The earlier part of the body whorl is sculptured with thick transverse folds but these diminish rapidly in size medially; near the outer lip, however, there is a large fold stronger than any of the others. Below this in the outer lip, there is a protruding lip tooth. The base of the whorl is marked with about ten spiral bands with occasional secondary cords between. The outer lip and anterior canal have been broken. The columella as for as can be observed lacks a columellar fold.

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[39] J. Hop. Univ. Studies in Geol., No. 3, P. 58, Pl. 2, Fig. 11, 1922.

[40] Acad. Nat. Sci. Phil. Proc., Vol. 69, P. 171, 1917. Vol. 73, P. 374, Pl. 32, Figs. 5,6, 1921.

Dimensions: Alt. 57 mm; Width 26 mm. Approximate, when perfect.

This recalls *P. dentilabris* (Gabb) but the Santo Domingan form has a strong oblique plait, a feature which is probably lacking on this species. In the Cornell collection from the Oligocene of Bailey's Ferry, Florida is a strikingly similar form labelled *Pyrazisinus harrisi* Maury, but I have not found this described or figured in the literature. The shell from Florida is somewhat smaller and only has four spiral bands instead of five on the whorls. In other respects, however, they are very similar.

Locality.—E. of Esperanza, Dept. of Bolivar.

Age.—Miocene.

Family NYCTILOCHIDÆ Dall

Genus DISTORSIO Bolten

Distorsio cf. simillimus (Sowerby) Plate 8, fig. 4

Triton simillimus Sowerby, Quart. Journ. Geol. Soc. London, vol. 6, p. 48, 1849.

Distortia simillima Gabb, Amer. Phil. Soc. Trans., vol. 15, p. 212, 1873.

Distortrix simillima Maury, Bull. Amer. Pal., vol. 5, No. 29, p. 271, pl. 17, figs. 4, 5, 1917.

Distorsio constrictus simillimus Pilsbry, Acad. Nat. Sci. Phil., vol. 73, p. 356, 1921.

A single worn specimen is very similar to Sowerby's species, but in the absence of the detailed sculpture I cannot be assured of their specific identity. It is questionable whether *D. gatunensis* Toula from the Gatun formation, *D. simillimus* Guppy from Jamaica, and *D. simillimus* Olsson from Costa Rica should all be considered synonymous with the true *simillimus* from Santo Domingo. The Colombian form seems closest to specimens from the latter locality.

Dimensions: Alt. 39 mm; Width 21 mm.

Locality.— E of Esperanza, Dept. of Bolivar.

Age.— Miocene.

This is much like *D. rimosum* Bôse from the I. J. T. which we have in a collection here but *rimosum* has long, bifurcated ribs not noticeable on the Colombian form.

Distorsio aff. **gatunensis** Toula Plate 8, fig. 3

Distorsio (Distortrix, Persona) gatunensis Toula, Jahr. K-K. Geol. Reich., vol. 58, p. 700, pl. 25, fig. 10, 1908.
Distorsio gatunensis Brown & Pilsbry, Acad. Nat. Sci. Phil. Proc., vol. 62, p. 356, pl. 26, fig. 8, 1912.
Distorsio gatunensis Pilsbry, **Ibid**, vol. 73, p. 356, 1921.

The whorls on a weathered specimen are less awry than on *D. simillimus* from Santo Domingo. The Colombian specimen also lacks the prominent angle on the body whorl with the two closely spaced cords. Furthermore, I have been unable to find and strong secondary revolving lines on our specimen, a feature well developed on *simillimus*. Their absence may be due to weathering but of this I am not assured. The nearest similar species is *gatunensis*.

Dimensions: Alt. 48 mm; Width 27 mm.

Locality.— Near Usiacuri, Dept. of Atlantico.

Age.— Miocene.

Genus BURSA Bolten

Bursa crassa colombiana n. subspec. Plate 8, figs. 1, 2

Fossil forms resembling *B. crassa* Dillwyn[41] have been found in Haiti, Costa Rica, Jamaica and Trinidad. The Colombian shell is a slight variant of the recent form and may be considered identical by some. The anal canal of the Colombian form is shorter and slightly more angulate than that of the recent species; nor do any of our specimens exhibit a tendency to produce larger or more elongated nodes on the angle of the body whorl. This latter is a feature on some of the recent shells of the true *crassa*.

One of the fossil forms to which *colombiana* is related is Olsson's[42] *B. crassa* from Costa Rica. The latter differs in lacking the finer interstitial threads between the major cords on the body whorl. From Santo Domingo there are two similar forms, one which has been called *B. crassa proavus* by Pilsbry[43] and the other *B. crassa* by Maury[44]. The former is a stubbier form than ours, while the latter is more like the recent shell in its elongated tubercules on the body whorl, particularly in back. Perhaps the most nearly allied species is *B. crassa bowdenensis* Pilsbry[45] which differs but slightly in having a longer anal canal.

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[41] Reeve, Conch. Icon., fig. 18.

[42] Bull. Amer. Pal., vol. 9, No. 39, p. 306, pl. 15, fig. 15, 1922.

Dimensions: Alt. 41 mm; Width 26 mm.

Localities.— Near Tubera; near Cedral; Morro Hermoso, Dept. Atlantico.

Age.— Middle Miocene.

Superfamily RHACHIGLOSSA Gray

Family COLUMBELLIDÆ

Genus STROMBINA

Strombina cyphonotus Pilsbry & Johnson Plate 7, figs. 9, 10

Strombina gradata Gabb (in part), Amer. Phil. Soc. Trans., vol. 15, p. 221, 1873. not **Columbella gradata** Guppy, Quart. Journ. Geol. Soc. London, vol. 22, p. 288, pl. 16, fig. 10, 1866.

Strombina cyphonotus Pilsbry & Johnson, Acad. Nat. Sci. Phil. Proc. vol. 63, p. 353, pl. 25, figs. 6, 7, 1911.

Strombina cyphonotus Maury, Bull. Amer. Pal., vol. 5, No. 29, p. 97, pl. 15, figs. 7, 8, 1917.

Strombina cyphonotus Pilsbry, Acad. Nat. Sci. Phil. Proc., vol. 73, p. 351, 1921.

A single specimen appears to be identical in every respect with the Santo Domingan form except for a difference in the character of the spiral sculpture on the anterior portion of the shell. On the Santo Domingan specimens the spiral threads are separated by wider interspaces where they are strongest, whereas on the Colombia species the sculpture is in the form of flat bands separated by incised, narrow interspaces. We have only one specimen but I doubt whether this difference is even of varietal importance, inasmuch as there is a tendency for such sculpture to vary on the same species.

Dimensions: Alt. 24 mm; Diam. 12 mm.

This is stubbier than *S. primus* Pilsbry and Johnson[46] and *S.*

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[43] Acad. Nat. Sci. Phil., p. 360, pl. 29, figs. 4, 5, 1921.

[44] Bull. Amer. Pal., vol. 5, p. 272, pl. 17, fig. 8, 1917.

[45] **Op. cit.** also Guppy, Quart. Journ. Geol. Soc. London, vol. 22, p. 288, pl. 18, fig. 9, 1866.

[46] **Op. cit.**, p. 352, pl. 25, figs. 9, 10, 1911.

lessepsiana Brown and Pilsbry[47] from the Canal Zone, besides differing in the strength and position of the body humps. *Columbella gatunensis* Toula[48] is probably equivalent to *lessepsiana*.

Locality.— Between Las Perdices and Pto. Colombia, Dept. of Atlantico.

Age.— Miocene.

Distribution.— Colombia; Santo Domingo.

Strombina colombiana n. sp. Plate 7, figs. 11, 12

Shell polished, fusiform, slightly askew, with a rather acutely tapering spire. Whorls about 11 when complete. These are flat above, but slightly convex below; sutures narrow. Body whorl globosely triangular, swollen above, acutely narrowing below, with an obtuse dorsal hump near the suture, and a slight swelling on the left side of the ventral face. Outer lip thickened, denticulated within with about 7 lirae. Columella with a faint suggestion of about three plaits. Anal fasciole, a narrow slit. Anterior canal short, flexed, somewhat wider below than above. Shell devoid of markings except on the anterior portion of the body whorl where there are faint revolving lines. It is difficult to say whether the absence of markings has been due to weathering or to the nature of the species.

Dimensions: Alt. 24 mm; Diam. 13 mm.

This differs from the foregoing in having a more globose form and lacking the longitudinal wrinkles. It is characterized by its porcelaneous shell and absence of sculpture.

Locality.— Near Tuberá, Dept. of Atlantico.

Age.— Miocene.

Family BUCCINIDÆ Troschel

Genus MELONGENA Schumacher

Melongena colombiana n. sp. Plate 7, figs. 2-4

Shell fairly large, quadrate. Spire shortly conic or conic depressed. Whorls about eight of which the earliest are weathered so as to obscure their characters. The body whorl is garnished with three rows of pointed spines each with about 6 spines or 18 in all. The upper row appears at or on the suture; the second row comes at the shoulder of the whorl, and the third about half way down. Between the upper and second series of spines, the whorl is concave with four or five prominent revolving lines; between the second and lowest series there are about nine spiral cords, and about seven below the lower series. Over the whole are fine arcuate growth striæ.

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[47] Ibid, p. 352, pl. 25, figs. 11, 12.

[48] Jahr. K-K Geol. Reich., p. 501, pl. 30, fig. 8, 1911.

The penultimate and the fourth from the last whorl is composed of an irregular blob of calcium carbonate much the same as the Eocene *Volutilithes* (*Plejona*) forms are wont to have. These often cover part of the whorl above. The remaining whorls are sculptured with radiating folds which on the third from the last whorl tends to develop into spines near the suture. The folds have a stellate appearance when viewed from above and are crossed by revolving striæ.

The anterior canal is quite broad and somewhat twisted. Umbilicus obsolete. Above it is a coarse revolving ridge. Inner lip with faint lines.

Dimensions: Alt. 60 mm; Width 41 mm.

The Colombian shell recalls *M. orthacantha* Pilsbry and Johnson from Santo Domingo but is larger and has three instead of two series of spines on the body whorl.

Locality.— E. of Esperanza, Dept. of Bolivar.

Age.— Miocene.

Melongena consors (Sowerby) Plate 7, fig. 5

Pyrula consors Sowerby, Quart Journ. Geol. Soc. London, vol. 5, p. 49, 1849.
Melongena consors Dall, Wag. Inst. Sci. Trans., vol. 3, p. 1584, 1903.
Melongena consors Maury, Bull. Amer. Pal., vol. 5, No. 29, p. 85, pl. 14, fig. 5, 1917.
Melongena consors Olsson. **Ibid**, vol. 9, No. 39, p. 112, 1922.
Melongena consors Weisbord, Pal. Venezuela, p. 294, pl. 7, figs. 1, 2, 1924.
Melongene consors Maury, Bull. Amer. Pal., vol. 10, No. 42, p. 208, pl. 35, fig. 12, 1925.

This is a common Caribbean Miocene species. It is characterized by its three rows of spines on the upper part of the body whorl and a single row below. The earlier volutions are sculptured with transverse folds and spiral threads.

Dimensions: Alt. 75 mm; Width 50 mm.

Localities.— Near Usiacuri; Near Puerto Coombia; between Sibarco and Piedras de Afilar; Dept. of Atlantico.

Age.— Miocene.

Distribution: Santo Domingo; Bowden, Jamaica; Springvale, Brasso and Manzanilla beds of Trinidad; Costa Rica; Falcon, Venezuela; Colombia.

Genus SOLENOSTEIRA Dall

Solenosteira falconensis (Williston) Plate 7, figs. 6 - 8

Solenosteira falconensis Williston, Pal. Falcon, pl. 7, figs. 12, 13, 1923. (MS)
Solenosteira falconensis Weisbord, Pal. Venezuela, p. 296, pl. 6, figs. 8, 9, 1924. (MS)

Shell biconic, solid, attaining a rather large size; spire somewhat less than half the length of the shell, acuminate. Whorls about eight, ornamented with subequal spiral threads and about eight transverse folds which merge into short pointed spines on the periphery. The whorls are slightly concave above, but just above the suture they become perpendicular. It is on this narrow portion that the sharply pointed folds appear. Body whorl convex above, sharply concave below. The contour of the last volution is much like the figure S. It is covered with numerous elevated revolving cords with a number of secondary threads between. The spiral cords become stronger just below the convexity of the whorl. In addition a closely spaced series of longitudinal, sinuous growth striæ overrun the shell. Outer lip subangulate, marginally fluted within, inner lip with a rather thick callus; umbilicus narrow, margined above by a thickened callus; anterior canal of moderate size for the genus, slightly flexed.

On old specimens the upper part of the body whorl is slightly convex above the peripheral series of nodes. The part of the shell behind the outer lip is traversed by about four or five, rather strong, thick, transverse folds extending from the suture to below the middle of the volution.

Dimensions: Alt. 42 mm; Width 29 mm.
Alt. 61 mm; Width 40 mm.

This is not unlike the Peruvian *S. alternata* (Nelson), but the present species has sharper nodes which are situated on the lower fourth of the whorl, whereas the angle of the whorl in the former is nearly medial. *S. dalli* Brown & Pilsbry is also very similar but has fewer and stronger spiral cords and a more medial position of the angle of the whorl. This species was first recorded from Venezuela.

Locality.— Near Tuberá; Near Usiacuri, Dept. of Atlantico.

Age.— Miocene.

Distribution.— Colombia — Dept. of Atlantico.
Venezuela — N. of Urumaco, Falcon.

Solenosteira cochlearis Guppy var. **magdalenensis** n. var., Plate 6, figs. 16, 17

Shell pyriform, solid. Whorls about seven, sculptured with strong, elevated, revolving ridges separated by wider interspaces. The grooves bear obsolete secondary spiral threads and closely spaced transverse growth striæ. In addition there are about twelve, thickened, longitudinal folds. Body whorl well rounded above, sharply tapering and somewhat concave below. The spiral ribs become somewhat stronger anteriorly. Inner lip lightly colloused. Umbilicus narrow. Outer lip strongly lirate within with about 14 liræ, being two less in number than the spiral cords of the body whorl. Anterior canal of moderate length, broad, slightly flexed.

Dimensions: Alt. 35 mm; Width 22 mm.

The form is closely akin to *S. cochlearis* Guppy[49] from the Springvale series of Trinidad. It differs varietally in having a slightly less globose body whorl, in having more and longer longitudinal nodes, and in the character of the ribbing. *S. cochlearis* has triangular ribs on the body whorl and are rather sharply ridged, whereas the ribs on the Colombian are elevated ridges and do not perceptibly broaden toward the interspace. *S. cochlearis* is a slightly more developed form than *S. semiglobosa* Guppy from the same series.

Locality.— One-half kilometer west of Piedras de Afilar, Dept. of Atlantico.

Age.— Middle Miocene.

Collector.— Mr. C. C. Addison.

Family VASIDÆ Adams

Genus XANCUS Bolten

Xancus magdalenensis n. sp. Plate 7, fig. 1

Shell ponderous, solid and heavy; spire with about 9 or 10 whorls when complete. Earlier whorls with about 6 wide rounded costæ at about the middle. These costæ later develop into large protruding rather pointed knobs. The whorls are sculptured with fairly strong revolving liræ and intercalary finer threads. On the later whorls, transverse growth lines become numerous and give a reticulate pattern to them. Sutures narrow, well incised. Body whorl nearly smooth above, but ornamented below with alternating stronger and finer revolving lines, crossed by fine transverse growth striæ. There are three strong columellar plaits, the anterior one slightly sulcate. Below this there is another weak fold. Umbilicus narrow and deep. Anterior canal long and narrow.

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[49] Bull. Amer. Pal., vol. 10, No. 42, p. 210, pl. 36, fig. 3, 1925.

Dimensions: Alt. (when whole) 190 mm; Aproximate width 93 mm.

This species is characterized by its five projecting knobs on each whorl and four columellar folds, of which the anterior is the weakest. The distance between the lower two plaits is about one-fourth that between the upper two.

This is very close to the recent *X. scolymus* but has fewer knobs and an additional columellar fold. This same distinction holds for *X. rex* Pilsbry and Johnson. In addition *rex* has decidedly more pronounced transverse growth striæ on the later whorls. *X. scopulus* Olsson from the Miocene of Costa Rica has a pronounced excavated sutural zone, a feature not present on this species.

Locality.— Near Tuberá, Dept. of Atlantico.

Age.— Middle Miocene.

Collector.— Mr. C. C. Addison.

Family VOLUTIDÆ Gray

Genus MITRA Lamarck

Mitra colombiana n. sp. Plate 6, figs. 11, 12

Cf. **Mitra henekeni** Hubbard, N. Y. Acad. Sci., vol. 3, pt. 2, p. 155, pl. 24, fig. 1, 1920

Shell slender, biconic; whorls about nine, sculptured with strong, raised, revolving cords separated by wide interspaces. The interspaces are sculptured with subequal, longitudinal threads. The body whorl is slenderly pyriform in shape with a maximum of about 13 revolving cords. Columella with four and possibly five plaits, of which the upper two are the strongest. Columella of moderate length, slightly twisted below.

Dimensions: Alt. 26 mm; Long. 8mm.

This species at once recalls *M. henekeni* Sowerby and *M. longa* Gabb. From the former it may be distinguished by its fewer revolving cords and one or two more columellar folds. Younger specimens of *henekeni* about the same size of our specimens generaally have three folds; very seldom there is a suggestion of a fourth. On the Colombian species, however, there are four well defined plaits on one specimen and five on the other. In this respect the species is similar to *M. longa* but the latter has a few more revolving cords with interstitial threads, a feature lacking on the present species.

Hubbard (*op. cit.,*) has figured a species from the Quebradillas limestone of Porto Rico which he has referred to *henekeni.* Our form is superficially very similar to Hubbard's — more so than to the true *henekeni.* The spacing of the revolving riblets on the Porto Rican shell is identical with that of the Colombian species. Unfortunately the mouth parts of the former are broken.

Localities.— Near Tuberá; between Las Perdices and Puerto Colombia, in the Dept. of Atlantico. E of Esperanza, Dept. of Boliver.

Age.— Middle Miocene.

Mitra cf. limonensis Olsson Plate 6, fig. 13

Mitra Swainsoni Broderip var. **limonensis** Olsson, Bull. Amer. Pal., vol. 9, No. 39, p. 272, pl. 6, fig. 1, 1922.

A single broken specimen, altho somewhat smaller than the Costa Rican form, appears to be nearly identical with it. Neither Olsson's nor our form show the characteristic transverse flexuous folds of *M. swainsoni* and for this reason I prefer to omit the varietal affiliation to *swainsoni.*

Dimensions: Alt. 36 mm; width 14 mm. (Aprox.)

Locality.— Near Tuberá, Dept. of Atlantico.

Age.— Miocene.

Genus CONOMITRA Conrad

Conomitra caribbeana n. sp. Plate 6, figs. 14, 15

Shell rather small, solid, coniform. Spire short, conic. Whorls seven, moderately convex, ornamented with low, flat spiral bands and transverse folds. The spiral bands are separated by narrower or equal interspaces. Body whorl shaped as in *Conus,* slightly convex above and narrowing rather gradually anteriorly. There are about 23 longitudinal riblets on it. Inner lip with four plaits of which the upper three are strongest and nearly horizontal, the fourth weaker and oblique.

This shell recalls the genus *Imbricaria* in shape. It is readily identified by its coniform outline and numerous *Lyria*-like ribs.

Locality.— Near Tuberá, Dept. of Atlantico.

Age.— Miocene.

Family OLIVIDÆ Orbigny

Genus OLIVA Martyn

Oliva cylindrica Sowerby Plate 8, fig. 7

Oliva cylindrica Sowerby, Quart Journ. Geol. Soc. London, vol. 5, p. 45, 1849.
Oliva cylindrica Gabb, Trans. Amer. Phil. Soc., vol. 15, p. 215, 1873.
Oliva cylindrica Guppy, Quart. Journ. Geol. Soc. London, vol. 32, p. 256, 1876.
Oliva cylindrica Cossman, Journ. de Conch., vol. 61, p. 57, pl. 5, figs. 2, 3, 1913.
Oliva cylindrica Dall, Wag. Inst. Sci. Trans., vol. 3, p. 1583, 1903.
Oliva cylindrica Maury, Bull. Amer. Pal., vol. 5, No. 29, p. 67, pl. 10, figs. 14, 14a, 1917.

Oliva cylindrica Maury, **Ibid**, vol. 10, No. 42, p. 195,pl. 33, figs. 3, 5, 1925.

Some of the Colombian shells are just a trifle less slender in the body whorl than specimens from the type locality, but in other respects are identical. Several years ago the writer collected several *Olivas* from the State of Falcon, Venezuela which are probably referable to *O. cylindrica.*

Dimensions: Alt. 31 mm; Width 14 mm.

This differs from *O. sayana immortua* Pilsbry and Brown[50] in having the top of the outer lip come some distance below the suture of the adjoining whorl.

Localities.— Between Las Perdices and Puerto Colombia; near Piedras de Afilar; near Usiacuri, in the Dept. of Atlantico.

Age.— Miocene.

Distribution.— Santo Domingo; Jamaica; Trinidad; Venezuela; Colombia.

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[50] Acad. Nat. Sci. Phil. Proc., vol. 69, p. 33, pl. 5, fig. 6, 1917.

Superfamily TOXOGLOSSA Troschel

Family CANCELLARIIDÆ Adams

Genus CANCELLARIA Lamarck

Cancellaria dariena Toula Plate 6, fig. 8

Cancellaria dariena Toula, Jahr. K-K. Geol. Reich., vol. 58, p. 31, pl. 25, fig. 13; pl. 28, fig. 2, 1909.
Cancellaria dariena Brown & Pilsbry, Acad. Nat. Sci. Proc., vol. 63, p. 345, pl. 24, figs. 3, 4, 1911.
Cancellaria dariensis Cossmann, Journ. Conch., vol. 61, p. 51, pl. 4, figs. 9, 10, 1913.
Cancellaria dariena Pilsbry & Brown, Acad. Nat. Sci. Phil. Proc., vol. 69, p. 32, 1917.
Cancellaria dariena Olsson, Bull. Amer. Pal., vol. 9, No. 39, p. 80, pl. 6, fig. 8, 1922.

Most specimens have a thickened transverse fold or varix at the outer lip or about the middle of the body whorl in back.

Dimensions: Alt. 40 mm; Width 20 mm.

This species has much in common with such forms as *C. barretti* Guppy, *C. epistomifera* Guppy and *C. guppyi* Gabb, but these have somewhat finer and more numerous transverse ribs. *C. rowelli* Dall is distinguished by the step-like succession of whorls and heavy, subequal transverse folds. *C. cossmanni* Olsson has a more widely spaced series of spiral and longitudinal riblets reticulating the shell into large clear cut squares.

Localities.— Near Pto. Colombia; near Tuberá, Dept. of Atlantico.

Age.— Miocene.

Distribution.— Colombia—Near Cartagena (Pilsbry&Brown)
Panama—Canal Zone; Water Cay.
Costa Rica—Rio Cocles.
Martinique?—(Cossman).

Cancellaria rowelli Dall Plate 6, figs. 9, 10

Cancellaria rowelli Dall, U. S. Nat. Mus. Proc., vol. 19, p. 307, pl. 29, fig. 1, 1896.
Cancellaria rowelli Maury, Bull. Amer. Pal., vol. 5, No. 29, p. 63, pl. 10, fig. 2, 1917.
Cancellaria rowelli Pilsbry, Acad. Nat. Sci. Phil. Proc., vol. 73, p. 333, 1921.
Cancellaria rowelli Olsson, Bull. Amer. Pa., vol. 9, No. 39, p. 84, pl. 6, fig. 7, 1922.

A single specimen appears to be referable to this species. The longitudinal ribs are about 21 in number and are strongly developed.

Dimensions: Alt. 23 mm; Width 15 mm.

C. harrisi Maury[51] is a very similar form and may be a mutation of this species.

Locality.— Between Esperanza and Jesus del Monte, Dept. of Atlantico.

Age.— Lower - Middle Miocene.

Distribution.— San Domingo—Rio Anima.
Costa Rica—East Grape Creek.

Cancellaria epistomifera Guppy var. **acuticarinata** n. var. Plate 6, fig. 7

The Colombian shell varies from the true *epistomifera* in having a rather sharp keel on the whorls. Part of the outer lip on our single specimen is broken but there seems to be no tendency to develop a spout or sulcus as on *epistomifera* proper. Further, there are no thickened transverse folds or varices but inasmuch as there is only one specimen I do not know if this is a constant feature or not.

Dimensions: Alt. 28 mm; Width 18 mm.

Locality.— Near Tuberá, Dept. of Atlantico.

Age.— Miocene.

Family TEREBRIDÆ Adams

Genus TEREBRA Lamarck

Terebra gatunensis Toula Plate 6, fig. 4

Terebra gatunensis Toula, Jahr. K-K Geol. Reich., vol. 58, p. 705, pl. 25, fig. 14, 1909.
Terebra gatunensis Brown & Pilsbry, Acad. Nat. Sci. Phil. Proc., vol. 63, p. 339, pl. 22, fig. 2, 1911.
Terebra (Myurella) gatunensis Cossmann, Journ. Conch., vol. 61, p. 13, pl. 1, figs. 26 - 29, 1913.
Terebra gatunensis Maury, Bull. Amer. Pal. vol. 5, No. 29, p. 31, pl. 4, fig. 5, 1917.
Terebra gatunensis Olsson, Bull. Amer. Pal., vol. 9, No. 39, p. 36, pl. 1, figs. 4 - 6, 1922.
Terebra gatunensis Anderson, Cal. Acad. Sci. Proc., 4th ser., vol. 16, No. 3, p. 89, 1927.

Specimens of *T. wolfgangi* Toula in the paleontological collection at Cornell differ from *gatunensis* in being smaller, more slender, and with the axial riblets far more prominent than the spiral cords.

Dimensions: Alt. 40 mm; Diam. 12 mm.

[51] Bull. Amer. Pal., vol. 5, No. 29, p. 64, pl. 10, figs. 9, 10, 1917.

Localities.— Cedral; near Piedras de Afilar, Dept. of Atlantico; E. Esperanza, Dept. of Bolivar.

Age.— Miocene.

Distribution.— Colombia—Depts. of Atlantico and Bolivar.
Venezuela—Urumaco, Sabaneta, State of Falcon.
Canal Zone—Gatun, Mount Hope.
Martinique.
Santo Domingo—Cercado de Mao.

Terebra bipartita Sowerby Plate 6, fig. 2

Terebra bipartita Sowerby, Quart. Journ. Geol. Soc. London, vol. 5, p. 47, 1849.
Terebra bipartita Gabb, Trans. Amer. Phil. Soc., vol. 15, p. 225, 1873.
Terebra (Acus) bipartita Dall, U. S. Nat. Mus. Proc., vol. 18, p. 38, 1895.
Terebra bipartita Maury, Bull. Amer. Pal., vol. 5, p. 187, pl. 3, fig. 14, 1917.
Terebra bipartita Olsson, **Ibid**, vol. 9, No. 39, p. 35, pl. 1, figs. 1, 2, 1922.
Terebra bipartita Anderson, Calif. Acad. Nat. Sci. Proc., 4th ser., vol. 16, No. 3, p. 89, 1927.

Two crushed fragments appear to be referable to this species. *T. subsulcifera* has a more prominent sutural band.

Dimensions: Alt. 45 mm; Width 11 mm.

Locality.— Morro Hermoso, Dept. of Atlantico.

Age.— Miocene.

Distribution.— Colombia; Santo Domingo; Costa Rica.

Terebra isaacpetiti? Maury Plate 6, fig. 3

Terebra Petiti Maury, Bull. Amer. Pal., vol. 5, No. 29, p. 31, pl. 4, fig. 4, 1917. Not of Kiener, Coq. Viv., p. 37, pl. 13, fig. 2.
Terebra isaacpetiti Maury, Bull. Amer. Pal., vol. 10, No. 42, p. 184, 1925.

Comparison with the large specimen of *isaacpetiti* in our Sto. Domingo collection shows a fragment from Colombia to be practically identical. This is one of the *inaequalis* group.

Dimensions: Alt. 32 mm; Diam. 16 mm. (Last 3 whorls.)

Locality.— Near Tuberá?, Dept. of Atlantico.

Age.— Miocene.

Distribution.— Colombia—Dept. of Atlantico.
Santo Domingo—Rio Gurabo.

Family TURRITIDÆ Adams

Genus TURRIS Bolten

Turris albida barretti (Guppy) Plate 6, fig. 5

Pleurotoma Barretti Guppy, Quart. Journ. Geol. Soc. London, vol. 22, p. 290, pl. 17, fig. 6, 1866.
Pleurotomella albida Olsson, Bull. Amer. Pal., vol. 9, No. 39, p. 59, pl. 4, figs. 1, 2, 1922.

The Colombian shell here figured is characterized by a strong medial keel on the whorls and a somewhat weaker revolving riblet above and below. Of the various *albida* forms, this shell is the nearest *T. barretti* originally described from Jamaica.

Dimensions: Alt. 45 mm; Diam. 16 mm.

Dall[52] and others following his lead regard a number of variable forms as being synonymous with *T. albida* a recent form first figured by Perry[53]. In comparing our specimens with Perry's figure, we found the resemblance to be very close but the recent species lacks the rather prominent cord above the medial keel. *P. haitensis* Sowerby[54] is characterized by its numerous revolving riblets standing out in sharp relief. The other forms of *albida* have been listed by Maury[55] and their affinities noted.

Locality.— E. of Esperanza, Dept. of Bolivar.

Age.— Miocene.

Distribution— Jamaica; Venezuela; Colombia.

Turris albida virgo Lamarck Plate 6, fig. 6

Pleurotoma virgo Lamarck An. s. Vert., vol. 7, p. 94, 1822.
Pleurotoma virgo Kiener, p. 5, pl. 3, fig. 1.
Pleurotoma albida Böse & Toula, Jahr. der K-K Geol. Reich., vol. 60, p. 241, pl. 13, fig. 18, 1910.

The Colombian specimens are nearly identical with the figure of *virgo* in Kiener (*op. cit.*) but are not as strongly striated transversely. The whorls are sculptured with three sharp revolving ribs of which the medial is the strongest. Slightly weaker ones occur above and below the suture of the whorl. In the wide interspaces are weak secondary threads. The suture is nearly indistinguishable.

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[52] Mus. Comp. Zool. Bull., vol. 18, p. 72, 1899.
[53] Conchology or the Natural History of Shells, pl. 32, fig. 4, 1811.
[54] Quart. Journ. Geol. Soc. London, vol. 6, p. 50, 1849.
[55] Bull. Amer. Pal., vol. 5, No. 29, p. 50, 1917.

Dimensions: Alt. 52 mm; Diam. 15 mm.

This is of the *albida* group, the synonymy of which is given by Dall and others. Of the various Miocene forms of *albida* this seems to be the closest to that figured by Böse and Toula from the Isthmus of Tehuantepec.

Locality.— Near Tuberá, Dept. of Atlantico.

Age.— Miocene.

Distribution.— Caribbean area.

Range.— Oligocene - Recent.

Genus SURCULA H. and A. Adams

Surcula nuevagranada n. sp. Plate 5, fig. 15

Shell fusiform, turreted; spire rather sharply tapering. Whorls about eleven, lightly keeled above the center, convex below, concave above. Sutures lightly impressed, bordered below by a small sutural cord. Whorls sculptured on the lower part with about twelve strong oblique transverse folds which are crossed by four or five spiral cords with weaker revolving striæ between. The concave portion of the whorl is smooth except for curved growth marks. Aperture subovate; anterior canal rather long, narrow, twisted.

Body whorl very convex above, sculptured anteriorly with subequal revolving cords. The longitudinal ribs extend about half way down the volution.

Dimensions: Alt. 37 mm; Diam. 14 mm.

Closely allied to the San Domingan *Drillia cercadonis* Maury[56] but is larger and has a slightly more twisted anterior canal. From the Isthmus of Tehuantepec, Mexico, Bôse[57] has described a closely related form named *S. pearsoni*, but the Colombian shell differs in having a more globose body whorl and a more excavated portion below the suture.

Locality.— Near Puerto Colombia, Dept. of Atlantico.

Age.— Miocene.

Collector.— Mr. C. C. Addison.

[56] Bull. Amer. Pal., vol. 5, No. 29, p. 52, pl. 8, fig. 12, 1917.

[57] Jahr. K-K Geol. Reich., vol. 60, p. 268, pl. 13, fig. 21, 1910.

Genus DRILLIA Gray

Drillia puertocolombiana n. sp. Plate 5, fig. 16

Shell of medium size, solid, turreted. Whorls 6+, convex, standing out sharply. Sculpture consists of 5 low flat spiral bands, separated by slightly narrower interspaces, and numerous sharp, oblique, transverse ribs, of which there are 22 to 26 in number. On reaching the top of the whorl these ribs bend considerably. Sutural zone deep; sutural line weak, bordered below by a sutural band. Below this there is a well channeled interspace between the top of the whorl and the sutural band. Outer lip with what appears to be a thickened fold or varix on back. Aperture subovate.

Dimensions: Alt. 43 mm; Diam. 16 mm; (Approximate when complete.)

Characterized by its deep sutural zone, flat spiral bands and numerous oblique transverse folds. It recalls *D. gatunensis* Toula from the Canal Zone but differs in its fewer spiral bands, and strong, excavated sutural area. *D. consors* Sowerby is more finely reticulate while the rather closely akin *D. venusta* Sowerby has sharper spiral threads.

Locality.— Between Las Perdices and Pto. Colombia?, Dept. of Atlantico.

Age.— Miocene.

Genus CYTHARA Schumacher

Cythara heptagona? (Gabb) Plate 5, figs. 13, 14

Mangelia heptagona Gabb, Amer. Phil. Soc. Trans., vol. 15, p. 211, 1873.
Cythara terminula Dall, Wag. Inst. Sci. Trans., vol. 3, pt. 1, p. 38, pl. 2, fig.5, 1890.
Cythara heptagona Pilsbry, Acad. Nat. Sci. Proc., vol. 73, p. 322, pl. 17, fig. 9, 1921.

A weathered specimen from Colombia is identical with *C. heptagona* in shape and dimensions. In the character of the spiral sculpture and in the number of longitudinal ribs (nine) the shell is similar to *C. terminula* Dall. Gabb originally described *heptagona* as having seven longitudinal folds but as intimated by Pilsbry, who regards *terminula* as synonymous, the number may vary somewhat.

Dimensions: Alt. 15 mm; Diam. 7 mm.

This is very similar to *C. cercadica* Maury[58] from Santo Do-
and *C. caimitica* Maury have nearly double the number of long-
mingo but the latter is slightly more slender. *C. polygana* Gabb
itudinal ribs. From Costa Rica, Olsson[59] has described two forms of which *C. terminula* var. *costaricensis* is closely related. It is a trifle more slender than the Colombian species but with a greater number of specimens for comparison the two forms may be found to be synonymous. The other Costa Rican species, *C. liminata* Olsson is a narrow, higher spired species.

Of the Caribbean *Cytharas,* three are very similar, these are:

C. heptagona Gabb
C. cercaidca Maury
C. terminula var. *costaricensis* Olsson

All these in turn are closely allied to the Pliocene *C. terminula* Dall of the Caloosahatchie series of Florida.

Family CONIDÆ Adams

Genus CONUS Linné

Conus molis Brown & Pilsbry Plate 6, fig. 1

Conus molis Brown & Pilsbry, Acad. Nat. Sci. Phil. Proc., vol. 63, p. 343, pl. 23, fig. 1, 1911.
Conus molis Maury, Bull. Amer. Pal., vol. 5, No. 29, p. 200, 1917.
Conus molis Olsson, **Ibid**, vol. 9, No. 39, p. 214, pl. 2, figs. 1, 2, 1922
Conus molis Anderson, Cal. Acad. Sci. Proc., 4th ser., vol. 16, No. 3, p. 89, 1927

Adult shells are large and ponderous. There are about 13 whorls of which the later ones are somewhat concave and spirally striate with five to eight revolving striæ. The striations on the body whorls of large specimens are confined to the lower portion of the shell and are faint or obsolete above.

Dimensions: Alt. 140 mm; Width 87 mm; Adult when complete.

Localities: Near Tuberá, Dept. of Atlantico.

Age: Miocene.

Distribution: Panama—Gatun.
Costa Rica—Water Cay, Banana river.
Haiti—Cercado de Mao.
Colombia—Tuberá.

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[58] Bull. Amer. Pal., vol. 5, No. 29, p. 61, pl. 9, fig. 15, 1917.
[59] Ibid, vol. 9, No. 39, p. 77, 1922.

Conus colombiensis n. sp. Plate 5, fig. 12

This species is thin-shelled. There are about 12 whorls, of which the earlier five or six appear to be somewhat coronate; the whorls are very convex, each succeeding one slightly overlapping on the preceding; sutures well incised; spire slightly elevated, concavely conical. The body whorl is well rounded at the shoulder. From the middle portion of the last whorl to the base there is a series of subequal revolving lines. These become obsolete above.

Dimensions: Alt. 58 mm; Width 34 mm.

The Caribbean Miocene analogue of this shell is *C. recognitus* Guppy which has been found in Costa Rica, Haiti and Jamaica. The body whorl of *recognitus* is distinctly pyriform whereas the Colombian shell is conical in shape. Otherwise the two forms are very similar.

Locality.— Near Tuberá, Dept. of Atlantico.

Age.— Middle Miocene.

END OF TEXT

The following plates were furnished by the author

EXPLANATION OF PLATE 1

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1	**Scapharca grandis colombiensis** Weisbord n. subsp. Near Usiacuri, Atlantico. Paratype. Alt. 85 mm; Long. 85 mm.	5
2	**Scapharca grandis** var. **cedralensis** Weisbord n. var. Paratype. Interior of left valve. Alt. 54 mm; Long. 61 mm.	8
3	**Scapharca grandis** var. **cedralensis** Weisbord n. var. Cedral, Atlantico. Paratype. Right valve. Alt. 60 mm; Long. 65mm.	8
4	**Scapharca chiriquiensis** Gabb var. **bolivari** Weisbord n. var. E. of Esperanza, Bolivar. Paratype. Exterior of right valve. Alt. 25 mm; Long. 31 mm.	8
5	**Scapharca chiriquiensis** Gabb var. **bolivari** Weisbord n. var. Exterior of left valve. Alt. 26 mm; Long. 31 mm.	8
6	**Scapharca chiriquiensis** Gabb var. **bolivari** Weisbord n. var. Exterior of large left valve. Alt. 39 mm; Long. 23 mm.	8
7	**Scapharca chiriquiensis** Gabb var. **bolivari** Weisbord n. var. Interior of small left valve. Alt. 26 mm; Long 31 mm.	8
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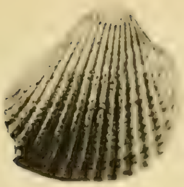
12	**Glycimeris lloydsmithi** Pilsbry & Brown. Exterior of right valve. Alt. 37 mm; Long. 35 mm.	10
13	**Glycimeris lloydsmithi** Pilsbry & Brown. Interior of same specimen.	10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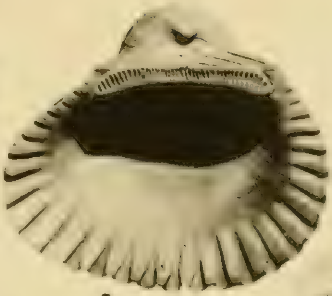
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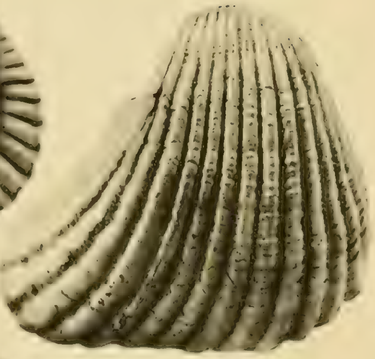
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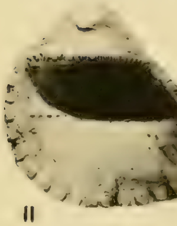
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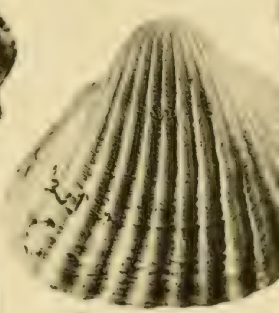
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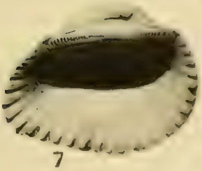
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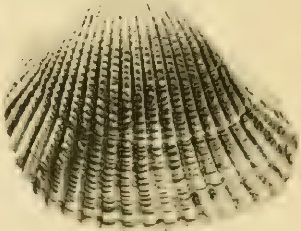
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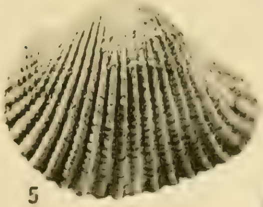
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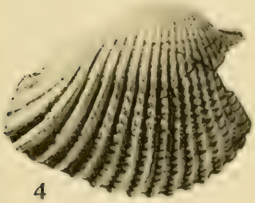
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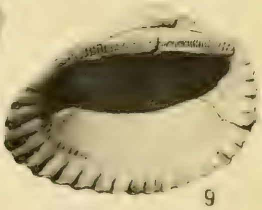
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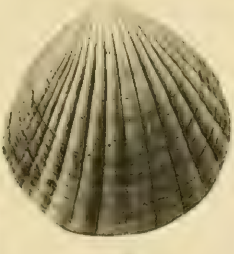
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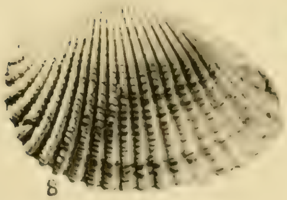
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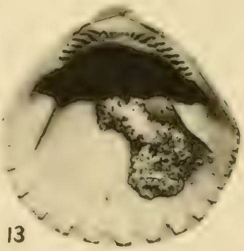
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EXPLANATION OF PLATE 2

Figure		Page
1	**Glycimeris lloydsmithi multicostata** Weisbord n. subsp. Exterior of right valve. Alt. 36 mm; Long. 34 mm.	10
2	**Glycimeris lloydsmithi multicostata** Weisbord n. subsp. Interior of same specimen.	10
3	**Glycimeris canalis var. colombiensis** Weisbord n. var. Exterior of left valve. Alt. 25 mm; Long. 26 mm.	11
4	**Glycimeris canalis var. colombiensis** Weisbord n. var. Interior of left valve. Alt. 24 mm; Long. 22 mm.	11
5	**Glycimeris cf. tumefactus** Pilsbry & Brown. Near Tuberá, Atlantico. Alt. 42 mm; Long. 44 mm. (Approximately)	11
6	**Ostrea osculum** Pilsbry & Brown. Near Usiacuri, Atlantico. Exterior of lower (left) valve. Alt. 26 mm; Long. 22 mm.	12
7	**Ostrea osculum** Pilsbry & Brown. Interior of lower (left) valve. Alt. 42 mm; Long. 30 mm.	12
8	**Ostrea messor colombiensis** Weisbord n. subsp. Near Piedras de Afilar, Atlantico. Interior of lower (left) valve. Alt. 53 mm; Width 33 mm.	12
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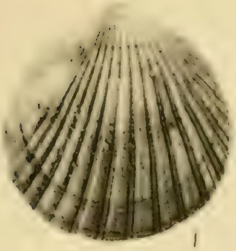
10	**Spondylus colombiensis** Weisbord n. sp. Near Tuberá, Atlantico. Interior of right valve. Alt. 75 mm; Long. 65 mm.	14
11	**Spondylus colombiensis** Weisbord n. sp. Exterior of same specimen.	14
12	**Venericardia dominica** new name. Exterior of left valve. Near Piedras de Afilar, Atlantico. Alt. 20 mm; Long. 20 mm.	17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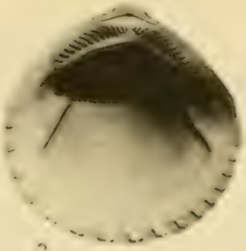
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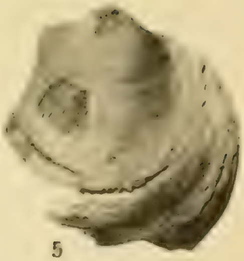
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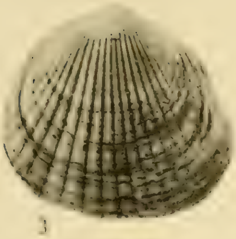
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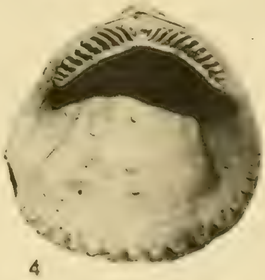
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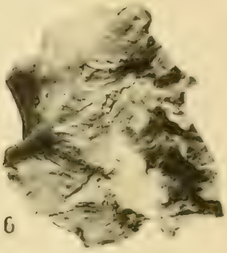
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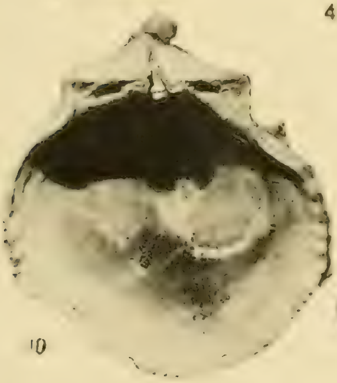
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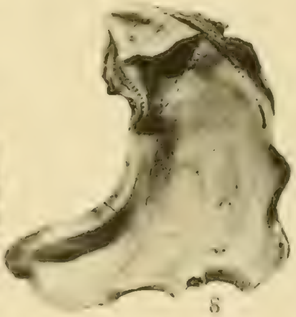
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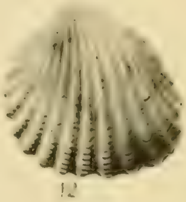
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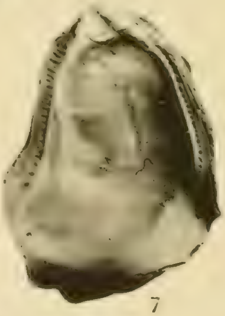
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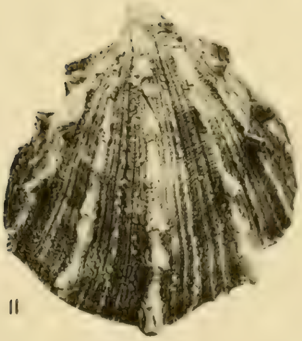
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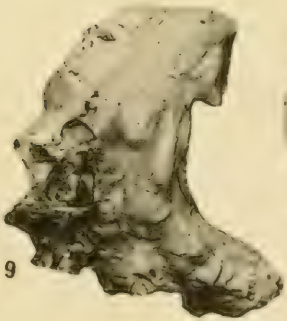
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EXPLANATION OF PLATE 3

FIGURE	PAGE
1—**Amusium luna** Brown & Pilsbry. Near Usiacuri, Atlantico. Alt. 115 mm; Width 120 mm.	13
2—**?Dermatomya harrisi** Weisbord n. sp. Near Tuberá, Atlantico. Alt. 43 mm; Long. 52 mm.	15
3—**Crassatellites reevei** Gabb var. **pleurorostra** n. var. Exterior of right valve. Alt. 40 mm; Long. 57 mm.	16
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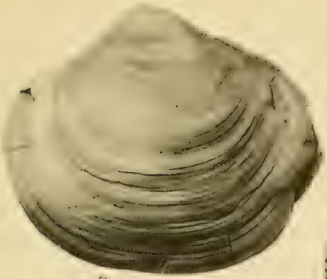
8—**Venericardia terryi** Olsson. Colombian specimen. Exterior of right valve. Alt. 32 mm; Long. 30 mm.	18
9—**Venericardia terryi** Olsson. Interior of same specimen.	18
10—**Venericardia dominica** new name. Near Piedras de Afilar, Atlantico. Interior of left valve. Alt. 20 mm; Long. 20 mm.	17
11—**Venericardia dominica** new name. Exterior of right valve. Alt. 24 mm; Long. 25 mm.	17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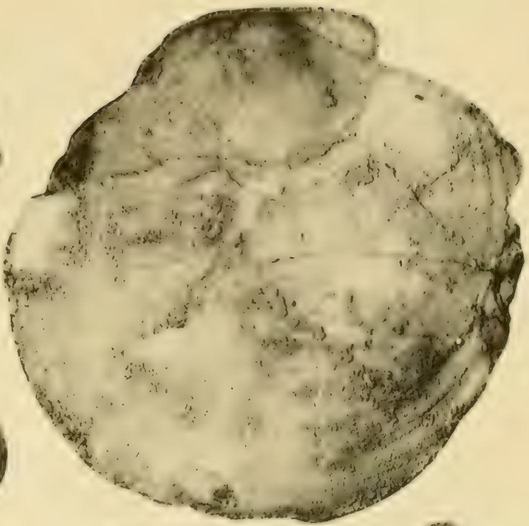
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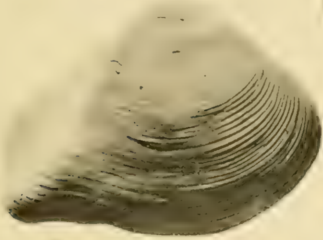
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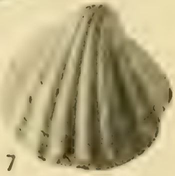
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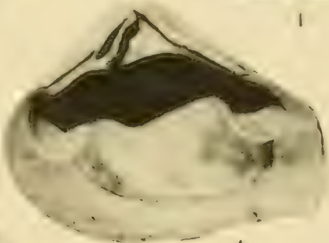
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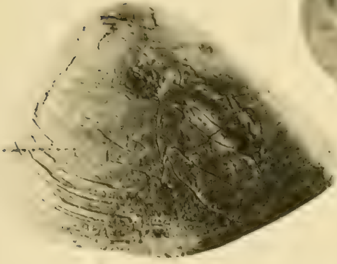
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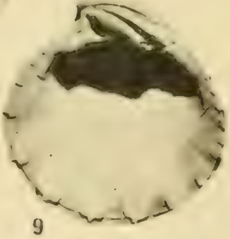
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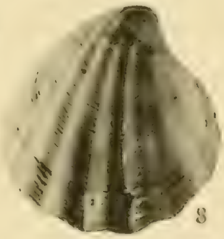
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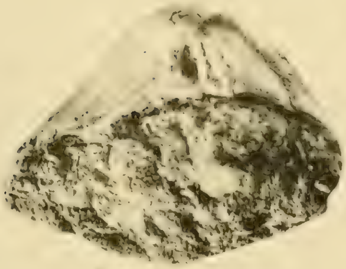
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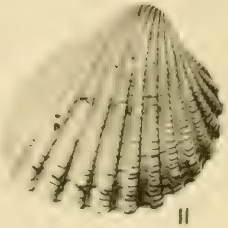
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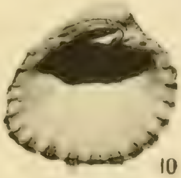
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Explanation of Plate 4

Figure	Page
1—**Venericardia dominica** new name. Near Piedras de Afilar, Atlantico. Interior of right valve. Alt. 24 mm; Long. 25 mm.	17
2—**Chama corticosaformis** Weisbord n. sp. Exterior of lower (right) valve. Alt. 45 mm; Long. 42 mm.	18
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valve. Alt. 37 mm; Long. 36 mm.	18
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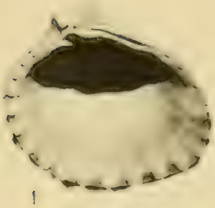
11—**Chione (Lirophora) usiacurina** Weisbord n. sp. Near Usiacuri, Atlantico. Exterior of left valve. Alt. 23 mm; Long. 28 mm.	23
12—**Antigona (Dosina) caribbeana** Anderson. Near Usiacuri, Atlantico. Alt. 145 mm; Long. 125 mm.	21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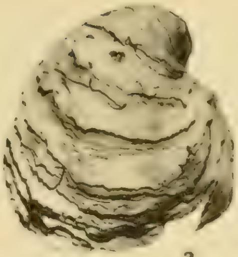
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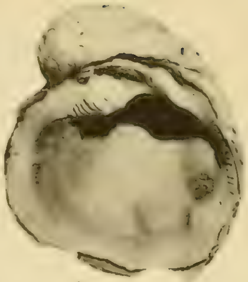
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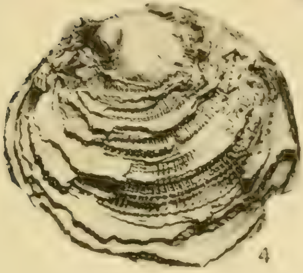
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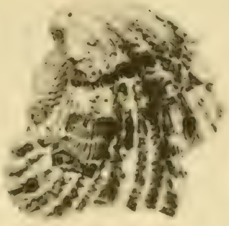
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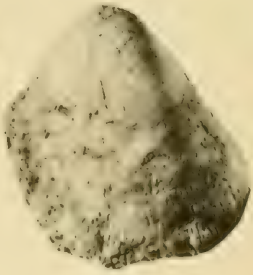
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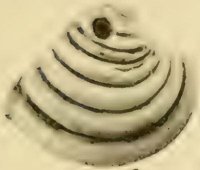
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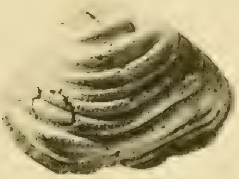
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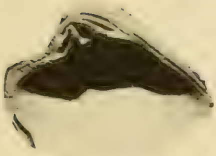
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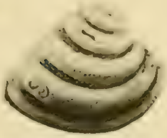
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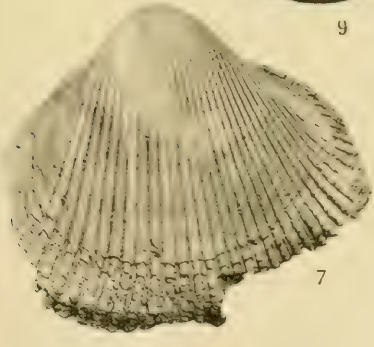
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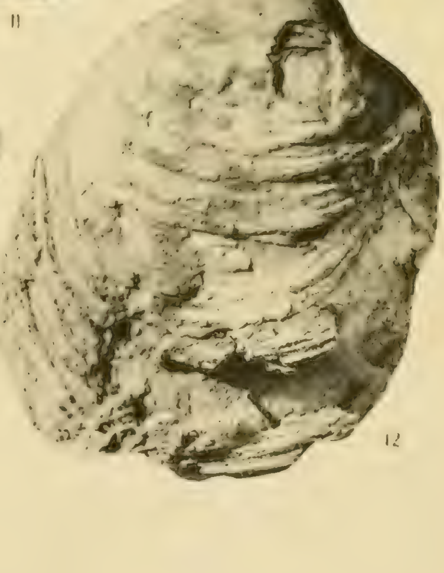
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EXPLANATION OF PLATE 5

FIGURE	PAGE
1—**Clementia dariena** Conrad. Usiacuri, Atlantico. Left valve. Alt. 23 mm; Long. 28 mm.	24
2—**Chione (Chione) bolivarensis** Weisbord n. sp. Jesús del Monte, Bolivar. Exterior of right valve. Alt. 20 mm; Long. 23 mm.	22
3—**Chione (Chione) bolivarensis** Weisbord n. sp. Same specimen showing radial ribs on and adjacent to the lunule.	22
4—**Asaphis delicatus** Weisbord n. sp. Venezuelan specimen from near Urumaco, Falcon. Exterior of right valve. Alt. 42 mm; Long. 59 mm.	25
5—**Asaphis delicatus** Weisbord n. sp. Colombian specimen from Usiacuri, Atlantico. Left valve. Approximate dimensions, Alt. 42 mm; Long. 56 mm.	25
6—**Metis trinitaria colombiensis** n. subsp. Near Usiacuri, Atlantico. Exterior of right valve. Alt. 46 mm; Long. 60 mm.	24
7—**Corbula (Cuneocorbula) hexacyma** Brown & Pilsbry. Near Jesús del Monte, Bolivar. Interior of right valve. Alt. 13 mm; Long. 21 mm.	25
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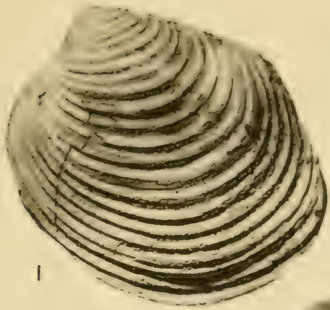
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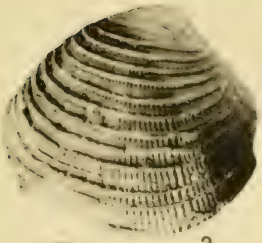
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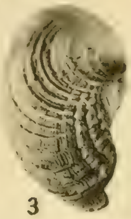
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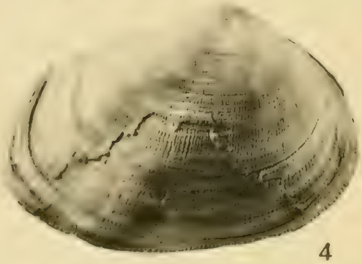
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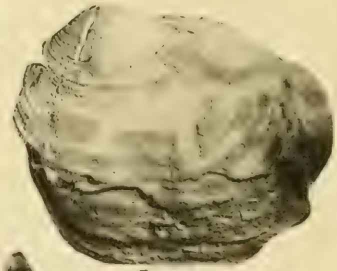
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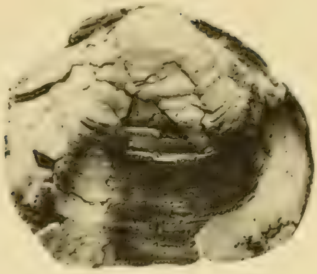
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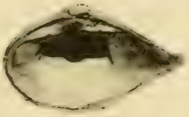
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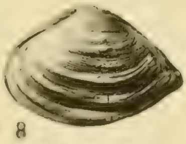
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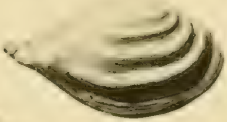
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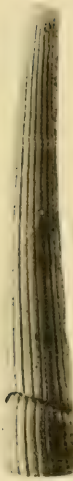
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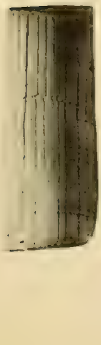
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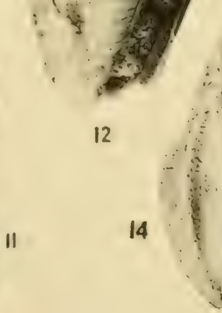
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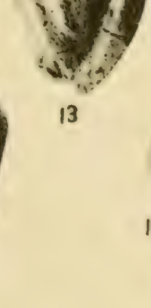
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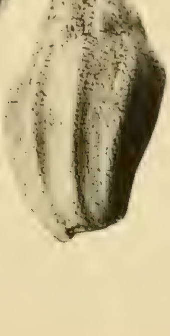
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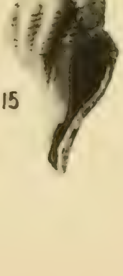
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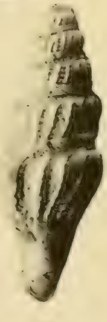
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EXPLANATION OF PLATE 6

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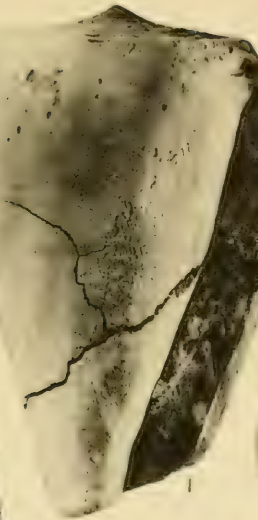
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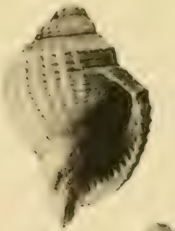
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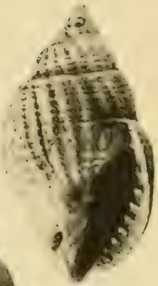
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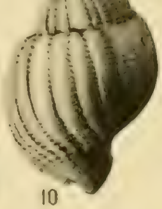
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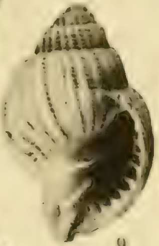
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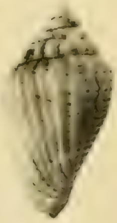
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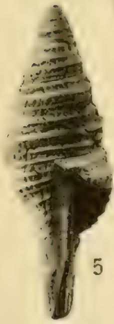
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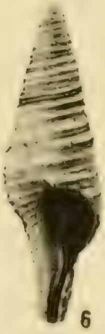
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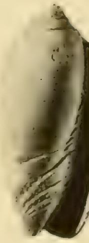
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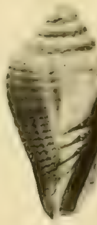
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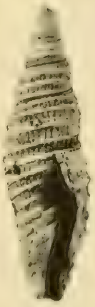
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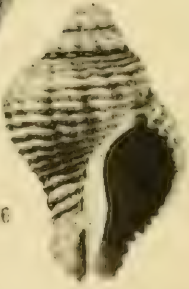
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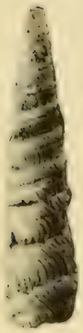
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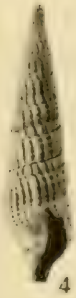
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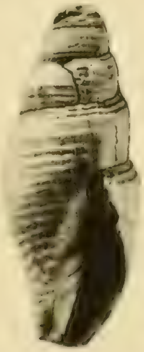
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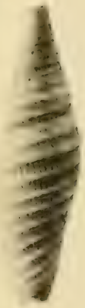
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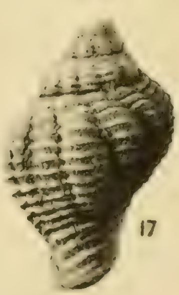
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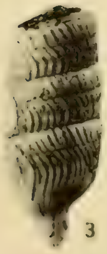
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EXPLANATION OF PLATE 7

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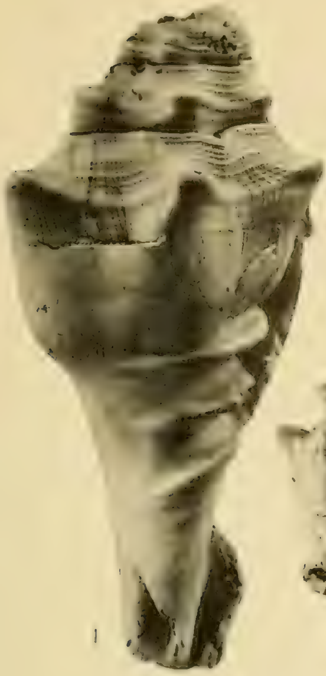

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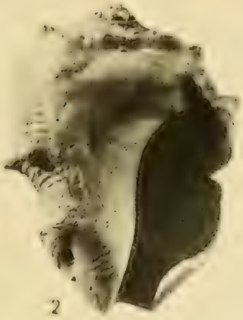

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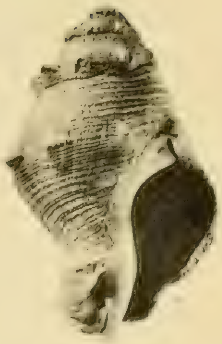

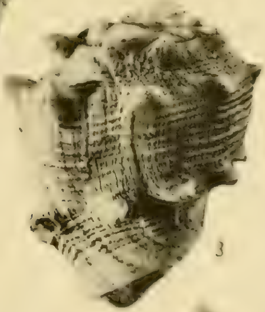

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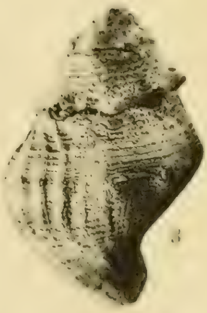

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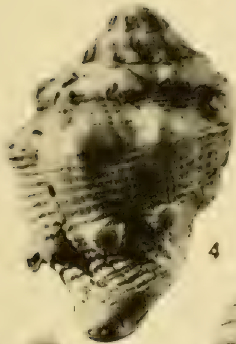

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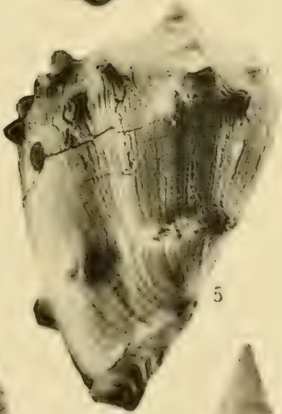

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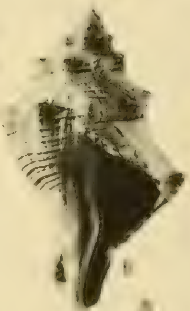

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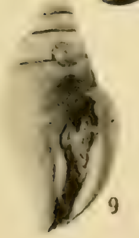

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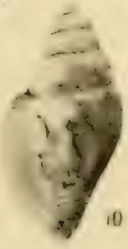

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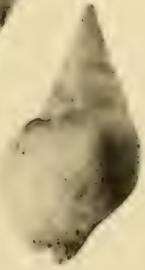

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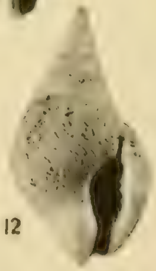

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Explanation of Plate 8

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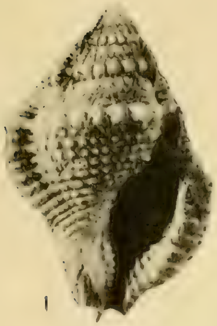
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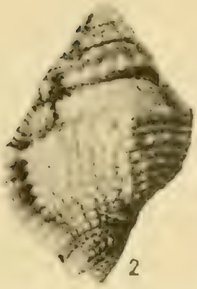
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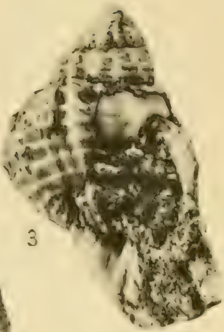
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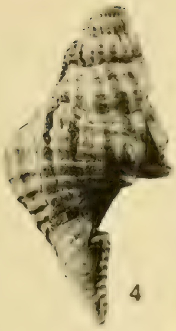
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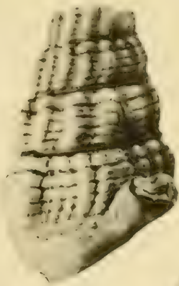
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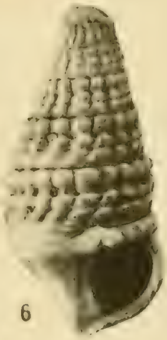
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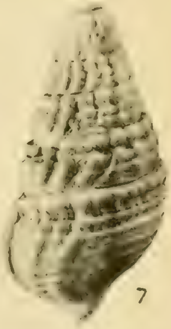
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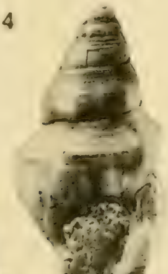
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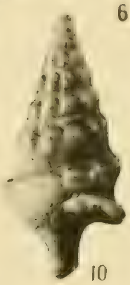
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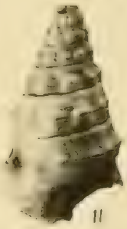
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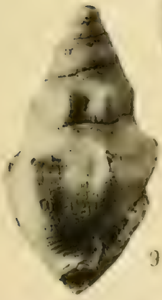
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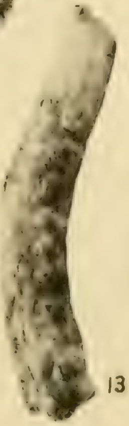
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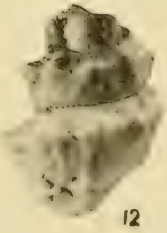
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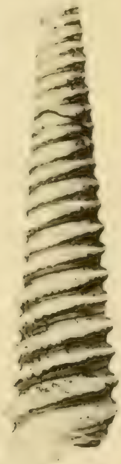
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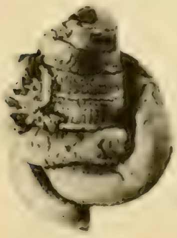
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EXPLANATION OF PLATE 9

FIGURE	PAGE
1—**Turritella cartagenensis** Pilsbry & Brown. Adult specimen of four and a half whorls. Alt. 55 mm; Width 20 mm.	30
2—**Turritella cartagenensis** Pilsbry & Brown. Specimen showing carinate early whorls. Alt. 45 mm; Width 15 mm.	30
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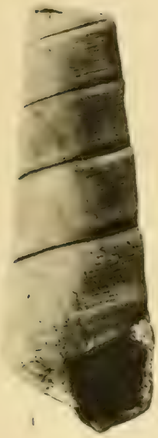
5—**Turritella lloydsmithi** Pilsbry & Brown. Alt. 50 mm; Width 17 mm.	31
6—**Turritella lloydsmithi** Pilsbry & Brown. Adult specimen. Lower three whorls. Alt. 43 mm; Width 23 mm.	34
7—**Turritella gatunensis** Conrad. Three medial whorls. Alt. 22 mm; Width 11 mm.	33
8—**Turritella** cf. **gatunensis taratarana** Hodson. Three medial whorls. Alt. 19 mm; Width 9 mm.	34
9—**Turritella altilira** Conrad var. **atlanticensis** Weisbord n. var. Holotype. Alt. 30 mm; Width 13 mm.	32
10—**Turritella** cf. **falconensis** (Williston) Hodson. Alt. 25 mm; Width 15 mm.	31
11—**Turritella vistana colombiana** Weisbord n. subsp. Paratype. Alt. 41 mm; Width 19 mm.	32
12—**Polinices (Mammilla) brunnea** Linck. Alt. 35 mm; Width 29 mm.	29
13—**Natica canrena (Linnaeus)** Moerch. Alt. 25 mm; Width 22 mm.	28
14—**Natica cuspidata** Guppy. Usiacuri, Atlantico. Alt. 35 mm; Width 56 mm.	28
15—**Architectonica granulatum** (Lamarck). Width 20 mm; Alt. 14 mm.	27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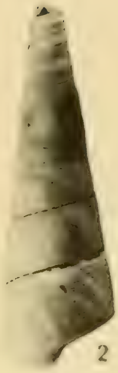
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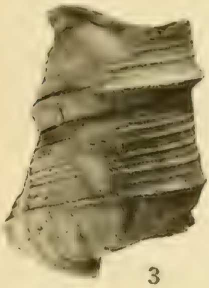
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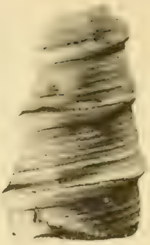
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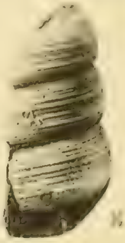
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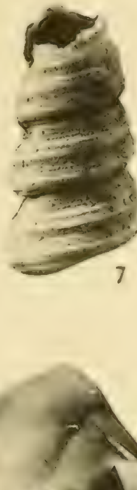
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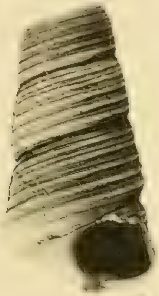
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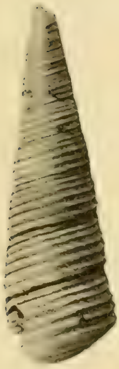
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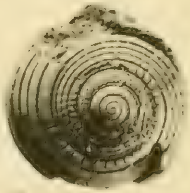
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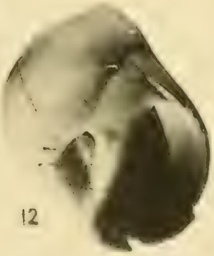
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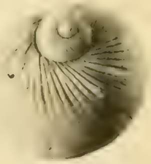
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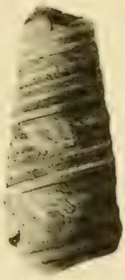
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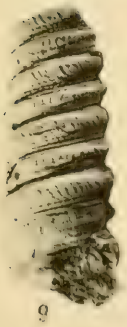
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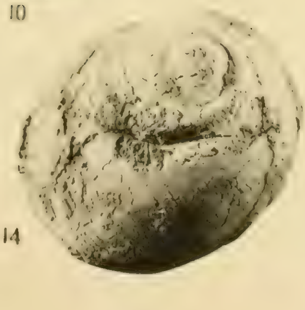
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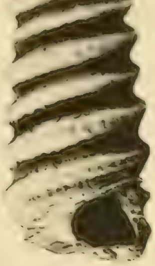
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